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THE AMERICAN GAS LIGHT JOURNAL

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BRIEFLY TOLD.

SIGNS OF RETURNING PROSPERITY.—We are glad to be able to say that the outlook returns received by us for the last two weeks of June and the first half of July are more than reassuring, in that the figures virtually prove that the shrinkage period has not only been passed, but that the days of increase are again with us. It is true that the increase is not of the sort which we have had in normal times, and it is also true that, compared with the corresponding weeks of 1892, a loss is shown; nevertheless the fact is that the industry is in a healthier condition than it was a twelvemonth ago—for, in these unsettled times, anything that indicates a gain must be taken as a sign of convalescence. Our returns are from 32 test points, all selected with a view to obtaining an accurate average of the business as a whole; and in only three of the places reporting was a reduction in the selling rate made. Six of the test points acknowledge a loss in output that averages 8 per cent.—this average would be considerably less were it not for the fact that in one locality a factory was closed down in June that had been running on half time since July, 1893, and the consumption of gas in the shops thereof amounted to 12½ per cent. of the local gas company's entire output—and the remaining 29 report gains (some of which, however, are quite small), the general average for the whole being 5.2 per cent. One fortunate manager rejoices in a 16 per cent. increase, the cause whereof, he frankly admits, is due to some lively canvassing that resulted in the placing of several gas ranges in his town. A very pronounced feature, in fact, of the situation is the unanimity of the admissions made that gas for fuel uses has been the saving factor. While no figures from any of the leading cities of the country enter into our compilation, we can say of our own knowledge, respecting the situation in New York city, that gaseous fuel supply has become a most important feature in the trading of all our companies; further, all are agreed that the progress in this direction is to be continuous. Looking the situation over calmly and dispassionately, only one conclusion is permissible, which is that the gas business is decidedly on the mend.

MESSRS. HUMPHREYS & GLASGOW ARE READY FOR BUSINESS.—The 31st day of July marked the retirement of Mr. Alexander C. Humphreys from the post of General Superintendent of the United Gas Improvement Company, the complex duties of which position were well performed by him for a period of almost 10 years; and the first of August found him engaged in business on his own account, in association with Mr. A. G. Glasgow, who had also served the U. G. I. Company with zeal and success. The new firm fairly seeks the whole gas world for its field, since its main offices are in New York and in London, England, and the gas engineers of the latter country have already felt the impress of its prowess, for Mr. Glasgow has been quietly (but none the less forcibly) showing them in a practical way how easy it is to produce a high candle gas by new methods that have gained a permanent footing in America. We know that every tub must eventually sink or swim, according to the condition of its staves and the excellence of the coopering that bound them together, and while we are forced to confess that the English gas engineer is a very conservative fellow, we nevertheless have a strong suspicion that he is able to appreciate a good thing, even

to the point of applying it practically, after he has had time to swallow his prejudices calmly. Of course, if the Newbigging theory, which is also sustained by other prominent British gas engineers, of decreasing instead of increasing the candle power of the gas at present supplied in London, is to prevail, why Messrs. Humphreys & Glasgow's mission in English territory will soon come to an end; but we imagine their stay on British soil will not be curtailed much because of this happening, for if Mr. Newbigging and his allies are of one way of thinking, we cannot forget that Mr. Dibdin and his supporters are equally unanimous in opposing the retrograde theories of the low candle power gas supporters. Messrs. Humphreys & Glasgow, however, are quite well enough up to the complications of the English situation in this respect, and so can be safely trusted to secure a victory, if such be possible. Meanwhile, they are ready to do business with all comers in their own land, where they are "quite at home." The American headquarters of the new firm are in the Manhattan Life Building, 64 Broadway, N. Y., and the London house is at No. 9 Victoria street, London, S.W.

NOTES.—The death of Herr Nikolaus Heinrich Schilling occurred on the 3d of July. Deceased was the originator of the *Journal fur Gasbeleuchtung*, a publication devoted to sustaining the gas lighting interests of Germany, and he, in connection with Dr. Bunte, maintained the paper on a very high plane. Deceased was General Director and Consulting Engineer of the Munich Gas Company, and was also an Honorary Doctor of the Ludwig-Maximilian University, of Munich. His knowledge of the gas business was most complete respecting either its theory or practice.——At a special meeting of the Directors of the Adrian (Mich.) Gas Light Company, held for the purpose of filling vacancies in the executive management of the Company. Mr. J. H. Webster, of Cleveland, O., was chosen President, and Mr. C. H. Raynor was chosen Secretary and Treasurer. Mr. Raynor has for years been the Company's Superintendent.——The following order was recently presented to the Chicago Board of Aldermen by Mr. Mann:

Whereas, The Corporation Counsel of the city of Chicago, in an answer recently filed by him in the Circuit Court of Cook County, has set up the claim that an electric light company incorporated in one part of the city cannot legally furnish electric current to another part of the city; and,

Whereas, The city, on account of such claim, has in several cases cut the wires of electric light companies; therefore, be it

Resolved, That the Corporation Counsel is hereby directed to report to this Council whether in his opinion the Hyde Park Gas Company and the Lake View Gas Company are empowered to obtain all their gas through the pipes connected with the old City Gas Company, where both Companies are not authorized to operate in the same territory, and whether, if not authorized, the city has the power to disconnect the pipes by which gas is now furnished from the old Gas Companies to the Hyde Park and Lake View Gas Companies.

Capital and Revenue Accounts of London Electric Lighting Companies.

Mr. Franklin L. Pope, in *Engineering Magazine*, calls attention to an analysis, prepared for the *Electrician* (London), of the capital and revenue accounts of the different electric lighting companies operating in the British metropolis, from which some interesting results may be deduced. The figures are given on the basis of the 8-candle power lamp as a unit. The average capital investment per lamp connected is $25, the best individual figure reached being about half that amount; the aggregate gross earnings for 1893 were $1,325,000, and the aggregate kilowatt hours registered by the house meters was nearly 10,000,000, an increase over the preceding year of about 25 per cent. The average market price per kilowatt hour in London last year was 12.76 cents; the average earnings of each lamp connected was about $1.85, and the average cost of coal per kilowatt hour sold was 2.65 cents, being a reduction of something like 10 per cent. over the previous year. The lowest coal bill per kilowatt hour was that of the Kensington Company, and was 1.48 cents. The *Electrical World* makes some computations based on the returns of the Massachusetts electrical companies to the State Commissioners, from which it appears that the average investment of capital per kilowatt capacity of the 10 largest stations in that State is $573, which certainly is a very high figure. The operating expenses in the same stations appear to average about 60 per cent. of the gross income. The average receipts per horse power hour cannot be exactly determined, but may be reasonably estimated from the returns as given to be about 12 cents per horse power hour. This, as will be seen, is considerably more than the London figure.

[Prepared for the JOURNAL.]

Electric Lighting versus Gas.

By MR. EDWARD M. HARRIS.

In the JOURNAL for July 16th it was clearly demonstrated, by evidences and reliable and valuable statistics, that the use of electricity for illuminating purposes throughout Great Britain is from two to three times as costly as gas, which the following additional facts corroborate.

A series of experiments, made in his own house on a domestic scale by an eminent scientist (a Professor in one of the Royal Colleges in England), with the object of ascertaining the actual cost of illuminating, for a period of 1,000 hours, by each of the following methods or devices, gave these results:

Argand gas burners—1,000 hours		.....	$10.00
Albo-carbon	"	.....	5.61
Regenerative	"	.....	4.50
Incandescent	"	.....	3.20
Electric incandescent lamps	"	.....	26.50

The figures speak for themselves, tell their own tale, and plainly show the desirability of using gas rather than electric light, in so far as economy of cost *alone* is concerned, other points of advantage not *now* being considered.

Again, the Managing Committee of the Army and Navy Club, Pall Mall, London, recently introduced electric lighting in part substitution for gas. The bill for March quarter amounted to over $1,000 for less than 200 lights, while the gas bill for the same period was not materially diminished. Hence the Club discarded the partial electric lighting and now use gas entirely. Indeed, a considerable percentage of the principal and aristocratic of the London Clubs, who have paid large sums for the installation of the electric light, and adopted it wholly or partially, are loud in their complaints of the unreasonable and excessive charges made by the companies supplying the electric current, which they declare to be oppressive; and a meeting of the Secretaries of the following Clubs has been held to discuss the subject of demanding a reduction:

"White's," "Devonshire," "Travellers," "Windham," "Reform," "Brooks'," "Junior Army and Navy," "Thatched House," "National," "Oxford and Cambridge," "Conservatives," "Orleans," "St. Stephen's," "Prince's," and the "National-Conservative."

A deputation of the Secretaries was unanimously agreed upon and appointed to wait upon the Directors of the Companies supplying these Clubs, and request them to make a considerable abatement in the charges.

In May last a proposition was made to the Corporation of the town of Folkestone, England, to substitute electric lights for gas in the lighting of the streets and public buildings of the town. A meeting of the Town Council was called and a resolution in favor of the proposition adopted. Subsequently the ratepayers called a meeting, whereat the abandonment of the resolution of the Town Council was emphatically called for. In consequence the Mayor convened a public meeting, at which the opinion of the public was dead against electric lighting, and the meeting declared unanimously in favor of gas, as it met all the requirements of the population at a third, or a fourth probably, of the cost of electric lighting. The resolution of the Town Council was therefore rescinded.

By the enterprise of a Glasgow newspaper, whose representatives interviewed some of the firms who have introduced the electric light in that city, the following interesting and instructive opinions and experiences were obtained:

"Light good, but so extremely expensive that we have to exercise strictest economy in its use. Cost three times gas."

"Cost $850 for the darkest three months, as compared with $350 for gas. No advantage in distinguishing colors."

"Cost three times gas; no good for distinguishing colors."

"A private installation costs much more than gas; electric light is very costly."

"Cost four times gas, and saved a dozen boxes of matches in a year; seriously thinking of returning to gas."

"My bill was $3,000 a year for lighting my billiard saloon (16 tables). Now my own installation with a gas engine lights 24 tables at a cost of $1,165."

"Nae doot it's a braw licht, but I got a awfu' shock"—*i. e.*, when he got a bill for $320, as against his former $90 for gas.

Opinions vary much concerning the advantages of electricity over gas as an illuminant, but the numerous and authentic instances now and previously given establish an axiom that electric lighting is from, at least, double to treble as costly as gas.

Consumers of artificial light, said a speaker addressing an appreciative audience, at a large and influential meeting, lately held at Camberwell (a populous suburb of London), before deciding to adopt an illuminant should exercise great care and caution. They should acquaint themselves not only as to its cost, but also as to its reliability, its danger to life and property, its quality and power of light, and also as to the effects and defects generally of its use. He then dilated at some length upon the unreliability of the electric light, an important matter to both public and private consumers, remarking:

"The electric lights, both the arc and incandescent, impartial observers must admit go out with little or no warning, and frequently do not reappear for a considerable length of time, in some cases for hours; they burn very irregularly and unreliably, even when they do not go out entirely; the strength of the light often falls to one-half its nominal value and even less, and rises again just as often, causing great inconvenience, especially to the consumers."

It is a noticeable fact that wherever the electric light is installed in a public building, gas burners are kept in readiness to serve in cases of need, which manifest themselves continually. Indeed, some public bodies and many private firms, when approached with a view to adopting the electric light in substitution for gas, have declined to do so on account of its unreliability, and others who had been induced to adopt it have discontinued its use and returned to gas for the same reason.

The following instances of the unreliability of the electric light have all occurred within the last fifteen months, since the latest improvements, concerning which so much has been said, have been brought into action.

In March last no less than 34 arc street lamps failed, soon after midnight, in the West End of the city of London, and were not relighted for the remainder of the night.

In May the electric lamps in the House of Commons went out for about half an hour; but the House itself was not affected by the occurrence, as it, and also the clock tower, are still lighted by gas.

In the north of London, August last, the electric lamps in one whole street went out altogether, leaving the street in complete darkness for upwards of an hour.

In the British Museum, last winter, one or other of the electric arc lamps kept constantly going out, leaving the students in semi-darkness, while the loud and continuous hissing noise of these lamps proved a serious and annoying interruption to steady work.

In the city of London, in December, on a Sunday evening, the electric lights in 17 streets, extending from Ludgate Hill to Moorgate street, went out; and the city authorities called upon the Gas Company to light up the gas lamps.

The electric light failed at a *conversazione* given in August last by the Mayor and Corporation of Newcastle, in the Natural History Museum, to the British Medical Association.

The Corporation of the city of Dublin also had a similar and somewhat singular experience in December, when discussing an estimate about the electric light. During the meeting, which was being held in the City Hall, the incandescent lamps went out, leaving the hall in darkness until candles were brought in. The gas fittings had been removed.

Portland Cement.

It has been repeatedly shown that the tensile strength of coarsely ground cement, gauged neat, is much greater than that of the same cement finely ground, but that the tensile strength of a mixture of the former with sand is much less than that of a similar mixture made with the latter. For example, Messrs. Dyckerhoff found that cement which would leave a residue of 10 per cent. of coarse particle on a sieve of 400 meshes to the square centimeter (equal, say, 2,500 meshes per square inch), has a tensile strength when gauged neat nearly 42 per cent. greater than that of the same cement from which the coarse particles had been removed by a sieve of 5,000 meshes to the square centimeter (equal, say, 32,000 meshes per square inch), but that a mixture of 1 part of the fine sifted cement to 3 of sand had 41 per cent. greater tensile strength than a similar mixture made with the unsifted cement, this percentage being increased to 64 in the case of a mixture of 1 cement to 5 sand—the samples in each case were 25 weeks old.

Similar results have been obtained by many others who have investigated the subject. In one series of experiments made by the writer, it was found that adding 20 per cent. of the coarse particles to fine sifted cement decreased the tensile strength by 47 per cent., the age of the sample being 8 days. Taking all the evidence into consideration, there can be no doubt that the tensile strength of neat cement is a comparatively useless test in assisting us to form a correct judgment as to the true value of the material; nor does it seem reasonable to expect that the tensile strength of any material should be any indication of its cementing power. If, however, it should be desired to know the true tensile strength of cement, the active portion alone should be used, the inert portion being removed by a No. 180 sieve.

Second Test.—In this test the proportion of 1 cement to 3 sand has been generally adopted, this proportion allowing the briquette to harden sufficiently for testing within a convenient period, say 28 days; it also forms a compound in which, when gauged, the cement and water completely fill the interstices of the sand, the standard sand being such as will pass through a No. 20 sieve (20 meshes to the lineal inch), and be stopped by a No. 30 sieve (30 meshes to the lineal inch).

That another element besides the tensile strength of the cement is developed in this test, is manifest from the fact that although only one-fourth of the sample consists of neat cement, the breaking weight of the mixture, even with coarsely ground cement, is generally one-third, and with finely ground, four-fifths, of the breaking weight of the neat cement, coarsely ground cement being such as will leave a residue of 10 per cent. on a No. 50 sieve, and the finely ground such as will all pass through a No. 180 sieve.

By the introduction of the sand test a step was made in the direction of more correctly estimating the qualities of cement on which its value depends, and the test is applied under conditions approaching more nearly those in which the material enters into construction. On the other hand, it is to some extent open to the objection that in practice mortar and cement are very seldom called upon to resist direct tensile stress.

The sand test is one partly of cohesive and partly of adhesive strength in unknown proportions, the strength of the compound being derived more from the latter than from the former, the granular form of the sand enabling it to present a relatively large extent of surface for the adherence of the cement. In the application of this test there can be no doubt that the truest results will be obtained by using the active portion of the cement only, or by allowing the inert portion to count as so much sand. The evidence is altogether in favor of this test, as compared with that of neat cement.

Fineness of Grinding.—Although the importance of fine grinding has been made increasingly manifest ever since cement began to come into general use, there still remains a singular laxity in the conditions imposed by English specifications as regards the degree of fineness to which the cement clinker is to be ground.

It is well known that the particles of coarsely ground cement which will not pass through a sieve of 180 meshes per lineal inch, are inert, and may be regarded simply as an adulterant, but in this country the sieve specified to be used to test the fineness of grinding is generally one of 50 meshes to the lineal inch, the apertures of which are about 13 times larger than those which are barely small enough to stop the inert particles, and even with a No. 50 sieve a residue of 8 or 10 per cent. is at present commonly allowed. In Germany the advantage of fine grinding in bringing out the valuable qualities of cement has long since been realized. In that country there is little difficulty in obtaining Portland cement ground sufficiently fine to leave no residue on a No. 180 sieve. That the finer cement is ground, the greater will be the cost of production, goes without saying, and the question resolves itself into the following: Cement as now generally sold in England contains on the average from 35 to 40 per cent. of inert material, *i. e.*, a residue of this amount is stopped by a No. 180 sieve; can the extra grinding required to convert this inert material into active cement be effected at an extra cost not exceeding 35 to 40 per cent? This question can best be answered by manufacturers.

Under any circumstances, fineness of grinding is an element which cannot be overlooked in determining the proportion of cement to be used in construction. If, for example, a concrete is specified to consist of 1 part ordinary cement to 8 parts of sand, broken stone, etc.—a not uncommon proportion—the actual proportion of active cement would be 1 to 13 or 14, or, in other words, such concrete would contain slightly over 7 per cent. of cementing material. If the coarse particles forming the residue on a No. 180 sieve are tested, they will be found to possess a very feeble cohesive strength, but this results from the presence of a minute quantity of the cement flour which adheres to the surface of the coarse particles; when this is removed by washing, the coarse particles will be found devoid of all cohesive or adhesive strength.

It should be observed, however, that the number of apertures to the inch (lineal or square) does not precisely define their actual size, which is, of course, affected by the thickness of the wire or silk threads used in making the sieve. For all practical purposes, a mesh of .003 in. by .003 in. in the clear will be found sufficient.

Weight per Bushel.—Although it has been well established that the weight per bushel has no connection with the tensile strength of neat cement, or of its compounds with sand, this test still continues to be included in the majority of specifications.

Apart from the inaccuracy of such a method in comparing weight and bulk, this test is calculated to lead to erroneous conclusions. For example, it is very commonly specified that the cement, in its dry and uncompressed condition, shall have a minimum weight of 112 lbs. per bushel, and leave a residue not exceeding 10 per cent. on a No. 50 sieve.

The cement fulfilling these conditions would, if more finely ground —say to pass a No. 180 sieve—and its value thereby increased by 35 to 40 per cent., fall considerably short of the specified weight. The weight per bushel should, therefore, be discarded as a test of the quality of cement.

Color.—In the older specifications it was usual to provide that the cement should have a definite color, which was variously defined as grey, greyish drab, etc., but this test is now generally omitted. Recently, however, it has been proposed that cement should be specified to be of a uniform dark color. What is known as good cement has, no doubt, a grey color, but the shade or tone depends very much on the grinding, and it will generally be found that finely ground cement is of a much lighter color than when coarsely ground. A careful review of the present system of cement testing leads to the following conclusions:

1. That the strength of a mixture of cement and sand is the most reliable of the present tests.
2. That the tensile strength of neat cement may be omitted altogether as a test of good quality.
3. That the weight per bushel is misleading, and should be omitted altogether.
4. That color is not of sufficient importance to be considered as a test.
5. That extreme fineness of grinding is so absolutely essential, that a sieve of not less than from 175 to 180 meshes to the lineal inch should be used for testing purposes.

The result of experience, therefore, compels us to arrive at the further conclusion that the present method of testing Portland cement requires very considerable alteration.

The Gas and Electricity Supply of Blackpool.

[A paper read by Mr. William Chew, M.E., before the Incorporated Gas Institute.]

To the members of this Institute, consisting of gas engineers, the part of this paper having reference to electricity may perhaps be thought a subject foreign to their interests. At one time, no doubt, this would have been the case; but the development of electrical knowledge during recent years has placed in the field previously held by gas a new agent, as a competitor therewith, for lighting, heating and motive power. As this new agent seems destined to create a disturbing element in the future prospects of the gas industry, and as the advisability, or otherwise, of having a dual supply is occupying the attention of local authorities throughout the country, I propose in this paper to lay before you an account of the work undertaken at Blackpool, which I trust will be of interest to the members generally. The town of Blackpool, as most of you are aware, is the seaside watering place of Lancashire. Its requirements may therefore be taken as typical of those of other towns; and the grounds on which the Corporation decided to have a dual supply are also applicable elsewhere, though perhaps in a less degree.

Commencing with the gas supply, as being the oldest and most important undertaking, let us examine how far it has fulfilled its purpose, and wherein lie the shortcomings that render it at all necessary to have an auxiliary supply by means of electricity. Without going into ancient history, which is well known, as to the origin of any gas works, it is evident that at some time or other the Blackpool Corporation became possessed of such works, and at the present time, in addition to their original purpose of lighting only, have added that of supplying an agent for cooking, heating and motive power. Experience has proved to them that for these purposes the use of gas has been well adapted and thoroughly reliable, and that, from a monetary point of view, it could be sold remarkably cheap in comparison with other agents, and at the same time yield a handsome profit on the investment.

However satisfactory these results in the use of gas may have been in the past, we must not overlook the fact that advances have been made of late years in matters of hygiene; and already this class of criticism has been brought to bear on the use of gas, with a view to discourage its adoption wherever possible. Exception is now taken to the combustion of gas in the production of light; and in this lies the chief advantage attributable to electricity as a lighting agent. Under ordinary conditions of usage, light from gas is obtained by combustion—the waste products and heat generated being radiated in the surrounding space; and should this happen to take place in a badly ventilated room, it will tend to further vitiate the air thereof. Further, with some burners an amount of unconsumed carbon is released, and this combines with the deleterious particles floating on the atmosphere of rooms, depositing itself at times in inconvenient places.

I am aware that these drawbacks to the use of gas have been greatly exaggerated, and apply only in a slight degree in the majority of uses to which gas is put. But taking as an example an ordinary apartment, where gas is only used about 4 out of the 24 hours on an average, we find so many counteracting agencies at work, that any chemical theories built upon the basis of the constituents of burning gases are rendered almost neutral in their application, owing to the circulation set up in a heated room from unseen sources. Were this not the case, owing to the depletion of oxygen and the increase of carbonic acid that can be calculated to have taken place in a room through the use of illuminants—such as gas, oil or candles—the same would soon become uncomfortable for habitation. But this does not happen where ordinary ventilation is allowed to take place. Nevertheless we find that there are a good many cases where ventilation is neglected, and circulation takes place in a haphazard sort of way; and as the tendency of the age is to have much more light than formerly, the result in such instances is an aggravation of existing evils. It is in this direction, then, that gas scientists must turn their attention, if they are to meet these modern requirements; and already there are signs of a new era dawning for the production of light from gas, on the lines of the Welsbach burner, which, besides cheapening the cost of light, has far higher hygienic properties than previous burners in use—so much so that already its sale has had a marked effect in limiting the use of electric light on the Continent, where the burners have been introduced on a large scale. These are the principal arguments advanced against the use of gas; and it is with a view to obviate these drawbacks that some sections of consumers are turning their attention to electric lighting.

We know that the requirements of all consumers are not alike in this respect, and that there are a certain number to whom it is a matter of importance to have a lighting agent giving a low calorific effect, with freedom of combustion, and a certain convenience of manipulation. To these, the question of cost is sometimes a secondary consideration, in comparison with the advantages supposed to accrue indirectly. It was for this reason, and on the assumption that there were many of this class of customers in our town who could well afford to pay for such lighting if made available for them, that our Corporation decided to put down an electricity works to supply the central parts of the town.

Before finally deciding to proceed, opportunity was taken to inquire into the demerits as well as the merits of the new system and its properties generally, in comparison with gas lighting. The plant required for its production was found to be much simpler than gas plant; a rotary alternator, driven by an engine, being all that was required to produce it on a large scale. But the distributing plant was more complicated, owing to the absolute necessity of having a uniform pressure. From this cause it appears that, although the amount delivered could be measured approximately by meter, yet it did not always follow that a given amount registered produced the same amount of light, even with the same lamps in use. Again, a most important factor was met with in the instability of the secured custom of large consumers, owing to the facility with which a private installation can be put down, and, if worked with cheap gas power, the electricity produced on the spot at less cost. This was soon manifest, for already in Blackpool there are four private installations in operation, having a working capacity of 200 units, or equal to the size of the central electricity works. So important does this question become, that immediately after the capital is expended the large customers are practically able to determine the price charged within very narrow limits to themselves; otherwise their custom, so essential to success, is lost, thereby entailing charges for unemployed plant, etc.

Electricity yields light or heat whenever a suitable resistance is offered to its passage; and this property is taken advantage of to obtain light in glow lamps. By means of raising a fine thread filament to incandescence (which can be accomplished by proportioning its thickness to the pressure and quantity of electricity passing through it), various degrees of light and heat are produced. The terms used to expres these quantities in technical language are as follows:

Resistance.—The standard is called an "ohm," being the resistance offered by 129 yards of No. 16 copper wire.

Volt is the standard of pressure.

Ampere is the standard of quantity.

Watt Hour is the standard of pressure × amperes × hours.

Unit is the standard of kilowatt hours, or 1,000 watt hours.

As I have already mentioned, the production of light depends on the quantity and pressure being maintained. So much so is this the case that, taking an ordinary glow lamp placed on a town main, where the pressure should be maintained at 100 volts when the standard light given out is 16 candles, should there be any falling off in pressure, the light diminishes at about seven times the rate of the drop. Thus, should the pressure fall (say) to 96 volts, the light given will be reduced to about 12 candles; and if the pressure rises above 100 volts, the opposite is the case. Then, again, the life of a lamp varies with the change of pressure, as follows:

Standard at 96 volts, 2,700 hours' life, yields 12 c. p. nominal.
" " 100 " 1,000 " " 16 " "
" " 105 " 300 " " 20 " "

Throughout the nominal life of a lamp the light gradually diminishes; so that the real effective life is much less for lighting, if we assume a lamp to be used up when the light drops from 16 to 14 candle power. The result of this to a consumer is that, although he may pay for a certain quantity of electricity, there are many considerations before he gets his equivalent in light.

The method of charging for light affords a similar analogy to that of gas, where the consumer, buying light, is supplied with a unit of gas, called 100 cubic feet—costing 3d. at Blackpool—which will yield him, when burnt in a standard burner, 3.6 sperm candle power per hour from each cubic foot used. In burning gas, however, the result depends on a minimum pressure being used; and this is under control at each burner, the pressure in the mains being kept slightly in excess of actual requirements in consequence. Though electricity is not sold in cubic feet, yet it fortunately so happens that the unit by which it is measured yields nearly the equivalent in light of 100 feet of gas; so that for purposes of comparison of cost a unit of electricity and 100 feet of gas approximately correspond. Electricity, then, is charged by the unit, and this is equivalent to the quantity of electrical energy supplied in one hour by a current equal to 1 ampere, which, multiplied by the pressure, yields 1,000 watt-hours, and is commonly called a kilowat-hour. Applying this rule to lighting, it is known that an ordinary long-life glow lamp takes 4 watts per candle for each hour used; but there are short-lived ones that can be had, taking 3 or 2½ watts per hour only. The best lamp to use is a matter for experts to decide; for, owing to the fluctuation in pressure on town mains, the rapid diminution of luminosity at different pressures, and other causes, it involves almost a mathematical calculation, suitable only to electricians. Until we get a lamp that will maintain a standard light, there are other costs incurred besides those for current, just as there are in some forms of gas burners. For outside lighting and large spaces with arc lamps, these remarks do not apply; as for this purpose I think electricity has no rival in the field.

These, then, are a few of the results found to be inseparable from an electrical supply; and when it is known that it is a physical impossibility to maintain an even pressure on all the mains, it will be patent that these are no little obstacles to be overcome as soon as the electrical company have emerged from the embryo condition in which most works are now placed.

As to the relative direct values of the cost of lighting, irrespective of the little shortcomings of both systems, the following is an approximate estimate of the cost of maintaining a 16-candle power light by gas and electricity at Blackpool

For 1,000 *Hours per Annum, under all Conditions.*

BLACKPOOL GAS.—Standard Value, 18-Candle Power, charged at 3d. per Unit, or 100 Cubic Feet.

Burner Used.	Candles per Foot.	Cost of 1,000 Hours.	Add Maintenance.	Total
Argand.....	3.6	11s. 0d.	1s. 0d.	12s. 0d.
Special	3.0	13 3	0 6	13 9
Common	2.5	16 0	0 3	16 3
Bad	2.0	20 0	....	20 0
Regenerating	10.0	4 0	Not known.	....
Welsbach.....	20.0	2 0	Not known.	....

BLACKPOOL ELECTRICAL SUPPLY.—Standard Glow Lamp, 16-Candle Power, Charged at 6d. per Unit.

Glow Lamps, Watts per Candle.	16-C.P. Watts.	Life of Lamp (estimated).	Cost of 1,000 Hours.	Maintenance.	Total.
4	64	1,000	32s. 0d.	1s. 6	33s. 6d.
3½	56	750	28 0	2 0	30 0
3	48	500	24 0	3 0	27 0
2½	40	....	20 0	Not known.	....
2	32	....	16 0	Not known.	....

These tables are necessarily founded on estimated cost, and are only to be taken inferentially—actual tests not having been made under ordinary working conditions.

After reviewing all the foregoing facts, it is palpable that electricity as a lighting agent has a certain commercial value, and given the possibility of sufficient support at the commencement of the undertaking, there is no reason why this agent should not be utilized to general advantage. This was the view taken at Blackpool before starting the works. I should here mention that still further confidence was given by the Corporation having had an electrical station going for 13 years previously, so that they had some knowledge of their own of its capabilities. In this works of an older type, electricity used to be produced at 3d. per unit; and on a larger scale, with modern plant, it was expected a less figure would be reached. During the periods between these years, various estimates were got out for a general scheme; and, as showing how unnecessary caution had perhaps been used, it was always assumed that a constant supply would be required, and under the knowledge at that time obtainable it was considered impossible from economical grounds. Eventually, after seeing the working in other towns, this was ignored; and we started to supply from dusk till midnight, which is now increased to an 18 hours' supply out of 24, although a compulsory supply can be demanded constantly. It is owing to the electric companies not always fulfilling their obligations, that a good deal of preliminary success is attributable.

Concluding these remarks on the subject, I will take the opportunity to describe the manufacturing plant of both agents, commencing with the gas plant and following with that used for the supply of electricity.

The gas works are alongside the local railway, with sidings and communication thereto. There are two gas-producing houses. No. 1 is a ground floor house with subway, 140 feet by 60 feet inside, and it contains 26 single ovens having 156 mouthpieces. No. 2 house is 220 feet by 100 feet inside, and it contains 18 through ovens, having 216 mouthpieces—the size, as in the other house, being 22 inches by 16 inches. The total number of mouthpieces, therefore, is 372, set in 62 ovens. The retorts are all heated by gaseous firing from 31 producers, being one to each 12 mouthpieces. Both machine and hand stoking are employed. The coals used for carbonizing are chiefly from the Wigan district, with the addition of cannel, to raise the illuminating power to 18 candles. The coal storage is alongside and between the two houses, and to manipulate the raw materials—the coal, coke, etc.—a steam locomotive, travelling crane, and fixed whipping crane are employed, a high-level line being in use throughout the works.

The gas, as it leaves the producers, has the denser hydrocarbons constituting the tar immediately extracted, and it is then received in the foul mains, in which are fixed hot friction screening appliances, for the precipitation and splitting up of the globules held in suspension, usually allowed to be carried with the stream of gases to the coolers. At the proper temperature, the gases are admitted to the air condensers, having a large adjustable surface capacity for cooling purposes. In this apparatus, the suspended water vapor, beyond the carrying power of the gas at a reduced temperature, is deposited in receivers. Experience has shown that it is essential to carry on distillation and condensation at a low pressure, and in a rarefied condition, to liberate the hydrocarbons.

At the end of these coolers, a set of rotary exhausters is so placed as to relieve this portion of the process from the high pressures caused by the purification and storage plants. These exhausters press the gas forward, first through the concentrated liquid process of purification, consisting of a tar extractor and tower scrubber, for the extraction of a percentage of the carbonic acid, sulphureted hydrogen and ammonia compounds, the remaining portion of the ammonia being removed by absorption in pure water in a separate machine.

These complete the liquor process of purification; that by the dry process being here taken up for the removal of the sulphureted hydrogen and carbonic acid. There are, for the first named impurity, four purifiers, 30 feet square, filled with oxide of iron for its absorption and deposition as a crystalline sulphur deposit therein. The carbonic acid is finally removed in four calcium purifiers, each 20 feet square. Final tests are here taken, and only gas that is free from these impurities is then registered by a large meter, and stored in the receiving vessels so characteristic of the locality of a gas works. The gas being measured into the holders, the total used (as indicated by the consumers' meters) shows the loss in distribution.

The storage capacity is 1,400,000 cubic feet, or equal to 27 hours' supply at the time of maximum demand. It is contained in two holders—a treble-lift one and a double-lift one—containing 600 and 800 thousand feet respectively. The ammoniacal products yielded from the manu-

facture are worked up on the spot into commercial sulphate, which is in demand as a fertilizer. Coke is sold locally, and some is sent away to other towns. Tar is forwarded to the distiller out of town, though a reserve tar distilling plant is kept on the premises, to be used whenever desirable.

In the distribution of gas, the first essential is that the pressure should be maintained throughout the system at not less than that fixed by the Act—this being the minimum allowed; and no part should have excess of pressure to compensate for insufficiency of main in other parts, as this excessive pressure tends to increase the leakage. The gas being stored in the holder at high pressure, is reduced to low pressure by means of a converter or governor, and distributed with a low pressure system of mains. There are large principal mains, with subsidiary mains leading therefrom, one in each parapet of the street, these latter being chiefly 3 inches and 4 inches diameter. The services are, with rare exceptions, all lead, and are laid in solid grooved troughing. There are about 50 miles of mains laid; and as proving the efficiency of the system, the leakage for a great many years averages 4 per cent. only. The internal fittings are subject to inspection, the bye-laws forming the basis of all plumbers' contracts. Architects generally insert a clause stipulating the bye-laws in dimensions of pipes, and this relieves them of a deal of responsibility. A special bye-law is in force as to the supply to stoves, and pipes laid in accordance with this insure a perfect supply. The bye-laws were adopted after actual experiments with different sizes of stoves at varying pressures and lengths of pipes.

Below is an abridged copy of the dimensions and forms

3.—With respect to the internal fittings, the following are the sizes and lengths of iron or lead to be used in the premises, according to the number of burners required:

Internal Diameter of Pipe.	Greatest Length Allowed.	Greatest Nember of Burners Allowed.
⅜ inch	20 feet	3
½ "	30 "	6
⅝ "	40 "	12
¾ "	50 "	20
1 "	80 "	40
1¼ "	100 "	60
1½ "	150 "	100
2 "	200 "	200

4.—With respect to gas stoves, the following regulations must be observed, as to the sizes of the pipes and the lengths allowed:

	Average Inside Size of Oven.			Distance of Stove from the Meter.		
Stove No. 0—	11 in.	× 11 in.	× 14 in.	Under 30 ft.	½ in.	pipe required.
	"	"		If 60 ft.	⅝ in.	" "
Stove No. 1—	14 in.	× 14 in.	× 24 in.	" 30 ft.	⅝ in.	" "
	"	"		" 60 ft.	¾ in.	" "
Stove No. 2—	15½ in.	× 15½ in.	× 24 in.	" 30 ft.	¾ in.	" "
	"	"		" 60 ft.	1 in.	" "
Stove No. 3—	19 in.	× 18 in.	× 24 in.	" 30 ft.	1 in.	" "
	"	"		" 60 ft.	1¼ in.	" "

BLACKPOOL,

Date.....189

TO THE GAS ENGINEER,

I,..... .....hereby give you Notice that I have completed the laying of the gas pipes in the manner required by your regulations, at Nos.....street, the property of Mr....., and the work is now ready for your inspection.

Size of main pipe..... .....
No. of preparations.....
No. of burners.....
Size of stove (or stove pipe).....
(Signed).....Plumber.
Address.....

N.B.—Plumbers must send this form to the gas office at least three days before plastering is commenced.

No covered pipes will be passed.

INSPECTOR'S REPORT.

I have inspected the above, and find them as stated (except .....and I recommend that the work be passed, and a.....inch service pipe be laid.

Distance from nearest main.....feet.
(Signature).....Inspector.
Date.....189

The standard pressure at which gas is sent from the station is, from sunset till 11 o'clock, 24-10ths; it being then gradually reduced to 8-10ths, till morning time, when it is increased to 14-10ths for the remainder of the day, except in the season proper, when what is termed stove pressue is applied at noon. The number of consumers attached to the mains is 5,700; and out of this number there are 2,500 gas-stoves owned by them, and 60 gas-engines. The effect of these cooking stoves on the consumption during the season is very marked, and causes rapid fluctuation in the demand, which greatly affects the storage capacity. The bulk of these stoves are idle during the winter months; and it is owing to this cause that our heaviest day's output is usually on the August Bank Holiday, which time, unfortunately for carbonizing, is the hottest period of the year. The maximum day's output is 1,250,000 cubic feet, against a minimum of 350,000 feet. There are 1,400 public lights in the borough; and these are in charge of the gas department.

The total amount of capital expended on the works to the present time is:

Land and buildings.....	£23,019	= 24 per cent.
Apparatus	40,034	= 41⅓ " "
Mains and services	22,634	= 23⅔ " "
Lamps and posts.....	3,196	= 3 " "
Meters.....	7,617	= 8 " "
Total..... ..	96,500	= 100

Towards the liquidation of this sum, an annual amount has been set aside, which now amounts to about £12,500; leaving the actual indebtedness at £84,000. With this capital, we made this year (to March 25 last) 242 million feet; being an increase of 34 millions over the previous year. I anticipate that, with an expenditure amounting to £3,500 more, we shall make 300 million feet per annum; so that the structural cost is £333 per million feet made per annum, or equal to 8d. per unit of 100 feet.

The financial results of the past show that, while the Corporation have set aside for redemption fund £12,500, they have also profited, during the last ten years alone, to the extent of £40,000, and at the same time given reductions in price from 3s. 9d. to 2s. 6d., which amount to another £40,000; making a total of £92,500, or almost enough to extinguish the debt, if so applied.

The result of the last year's working shows that the following profit has been made and applied:

Interest and sinking fund.....	£4,342	= 4⅓ per cent. on capital.
Town's purposes	5,590	= 6 " " "
Total	£9,932	= 10⅓ " " "

As a result of the year's working, gas is now reduced to 2s. 4d. per 1,000 feet, with a free meter still.

I will now describe the new electric works as fully as possible, that we may be acquainted with the class of competitor the new agent is likely to assume.

Wherever electricity works are first commenced for a general supply, it is difficult to forecast precisely the amount of light immediately required; but in Blackpool there are exceptional circumstances that cause a very large demand in proportion to the size of the town, from the existence therein of so many places of public resort, which vie with one another.

An approximate estimate was based on the requirements of these places; and a 200-unit glow lamp plant, with an 82-unit arc-lamp plant was fixed upon. Acting on this, electrical contractors were invited to submit estimates and designs, with the result that the works have been erected at a cost of £30,000. This was thought a large outlay; but it was estimated that, if only one-half was immediately put in operation, there would be little loss, whilst if the output should ever reach the capacity of the plant, then the profits would fast accrue, owing to certain fixed charges being almost stationary. This is the universal opinion of all electricians, even those that have half a million of capital laid out. The system adopted was that known as the alternate-current high-pressure system, with a converter to low pressure fixed in each consumer's premises; and for public lighting, a separate plant on the direct-current high-pressue series system.

The works, which adjoin the gas works and their railway sidings, consist of a boiler-house 123 feet by 68 feet, and a producer-house 123 feet by 55 feet. There are three Lancashire boilers, 28 feet by 7 feet, fitted with mechanical stokers, and apparatus intended for the consumption of smoke.

The producing plant for glow lamps consists of—

	Volt.	Amp.	Rev. per Min
No. 1*a*—100 unit rotary alternator.....	2,000	× 50	375
" 1*b*— 50 " " "	2,000	× 25	
" 1*c*— 50 " " "	2,000	× 25	
Total..200-unit output capacity.			

The driving power for these consists of compound coupled horizontal non-condensing engines.

No. 1*a*—200 I.H.P. at 90 revs. and 125 lbs. steam.
" 1*b*—100 " 120 " 125 "
" 1*c*—100 " 120 " 125 "

the power being imparted by cotton ropes.

The arc light plant consists of—

No. 1 dynamo 27½ units, maintaining 55 arc lamps of 10 amperes.
" " 27½ " " 55 " "
" " 27½ " " 55 " "
Total....82½ units " 165 arcs.

These machines run at the rate of 800 revolutions per minute, and are each driven by a 60 indicated horse power engine, the same type as the others.

This constitutes the plant of the producer house; the current being taken from each machine to a distributing board for combining or bye-passing the various circuits required. A testing resistance equal to the output of the largest producer is provided to be used when required. A suitable overhead crane for repairs is fixed to travel on the walls, and beyond several small testing instruments for measurement of current and pressure regulators. This constitutes the whole of the generating plant.

In the distribution of the current, great care has to be exercised in apportioning the sizes of the mains, owing to the cost of copper contained in them, and the loss of pressure if at all too small, for with too small leads, it is easy to expand 50 per cent. of the production in overcoming the resistance. The distributing mains are laid in 3-inch and 4-inch diameter turned and bored pipes on each side of the streets, in straight lines, with a brick-eye at easy distances. The cables are stranded copper wire, insulated with vulcanized india-rubber, and threaded into the pipes. These were laid without attempting to keep them water-tight, as the quality of the insulating material was so good. Being laid in straight lines, about 18 inches deep, they necessarily overlap the gas mains, and are liable to accumulate gas therein owing to disturbance of the earth in laying them. The effect of this will probably be seen later on, when the precise nature of the disturbance has been forgotten. The main leads are taken along some of the principal streets, at 2,000 volts pressure, and to consumers' houses, where the converters are fixed to yield 100 volts pressure to feed their lamps. A two-night test at one consumer's premises shows the effective pressure obtained therein.

Time.	Volts. Pressure.	Time.	Volts. Pressure.
7:10.....	108	7:25.....	111
7:22.....	104	7:40.....	107
7:25.....	94	7:41	94
7:28..... ...	96	7:47.....	99
7:30.....	94	7:50.....	96½
7:40.....	93½	7:58.....	97½
7:45.....	94	8:00.....	100
7:51.....	96	8:01.....	96½
8:00.....	94½	8:13.....	96
		8:30.....	96½

From this it will be perceived how difficult it must be to keep at 100 volts steadily, if under penalties.

There have been about 8,000 yards of mains laid connecting 20 lineal miles of wire; and on these are fixed about 60 consumers, several being very large ones. The public lighting is carried out on a brilliant scale on the Marine Parade; the lamps being about 50 yards apart and 25 feet high. They each use ½ unit of current per hour, and are known as 2,000 nominal candle power. In the main streets, 25 others are being erected. These displace 200 gas lights.

The works were put in operation on August 1, 1893, and the cost was as follows:

Land (rented)		
Buildings.....	£8,008 = 26½	per cent.
Apparatus.....	10,500 = 35	"
Mains and services.....	7,000 = 23½	"
Lamps and posts.....	4,000 = 13⅓	"
Meters, etc	500 = 1½	"
Total.....£30,008 =	100	

The output of the plant is calculated at 160,000 units per annum, equal to 4s. per unit made. In order to push the new light, the usual pamphlet was issued setting forth the hygienic capacity of the light in comparison with gas, and a few rules as to insulation requirements of consumers' leads. Canvassing consumers is strongly pursued also.

The scale of charges for current are scheduled as follows: Glow lamps by meter at 6d. per unit, with a discount ranging from 5 to 25 per cent. For private arc lighting, 2d. per hour for ¼-unit lamp equals 4d. per unit, less 10 per cent. discount. Promenade and town lighting at actual cost of current, ***plus*** maintenance.

As a result of starting the plant, the guaranteed customers to the extent of about 60 were quickly supplied; one of these taking alone fully one-third of the entire private consumption. The Corporation themselves are also large users, coming in for nearly half the total output, which, for the eight months previous to March 25 was:

	Units.
Produced at works for private use.....	55,600
" " public lamps (only half lit during winter)	22,560
Total	78,160

The works are now employed at their maximum output, the reserve plant being incroached upon thus:

Available output in one hour = 200 units.
Actually in use..... 195 "
Balance (reserve)..... 5 units, or 2½ per cent.

Arc Plant.

Available..... 155 arcs.
Actually used..... ..... 140 "
Reserve..... 15 arcs, or 10 per cent.

The following table will give an idea of the extent of the lighting since the commencement:

Schedule of Output per Week from Sept. 1, 1893, *to March* 1, 1894.

Date.	Alternating.	Public.	Private.	Total.	Working Cost. £ s. d.
1893.					
Sept. 9	1,265	....	....	1,265	47 5 5
16	1,691	....	....	1,691	44 6 0
23	2,086	....	173	2,259	42 17 1
30	2,026	....	337	2,363	48 11 3
Oct. 7	1,620	....	128	1,748	51 9 1
14	1,800	....	195	2,435	64 3 3
21	1,693	1,332	102	3,107	72 9 4
28	1,594	1,349	128	3,071	68 10 4
Nov. 4	1,685	1,369	140	3,194	64 19 1
11	1,786	992	195	2,973	59 19 4
18	1,660	895	98	2,653	41 6 9
25	1,628	823	133	2,584	39 10 4
Dec. 2	1,727	842	157	2,726	39 18 10
9	1,838	861	281	2,980	41 5 8
16	1,779	888	202	2,869	39 12 3
23	1,797	929	104	2,830	38 1 1
30	1,880	993	246	3,119	41 11 3
Units.....	29,555	11,713	2,619	43,867	845 16 4=
1894.					4.7d. per unit.
Jan. 7	1,781	948	145		
14	2,150	959	355		
21	1,903	943	238		
28	1,726	877	236		
Feb. 4	1,922	793	278		
11	1,728	816	220		
18	1,566	896	92		
25	1,634	745	114		
26 & 28	691	311	43		
Estimated to Mar. 25	44,656	18,911	3,940		

Summary.

Produced to March—Incandescent lamps	44,653	units.
" " Public lighting.....	18,911	"
" " Private arcs.....	3,940	"
	67,507	units.
March 25, estimated.....	10,719	"
Total product.....	78,226	units.

As there are several more customers ready to come on, the extensions

of the mains to supply them have already been put in hand; and a temporary plant has been put down till the permanent one can be erected. This new outlay will raise the capital to about £50,000; and the incandescent capacity will then be raised from 200 units to 450 units per hour.

One result peculiar to new electrical works is that the cheap high tension distributing pioneer system of separate transformers has in six months to be replaced with a new low tension system of distribution in the center of supply, by means of half a dozen transformers placed in the streets. In this way the difficulties attending the pioneer work will be reduced, as all house transformers will be abandoned where this system prevails. This is the second step towards having a central transformer station in the middle of the town where the future current will no doubt be distributed from—forming a kind of town governor house.

The result of the first half year's working can hardly be taken as a standard of future cost, the plant being partly in the hands of the electrical contractors, so that many items chargeable will consequently not appear. Besides this, increased output for longer periods is expected from the plant hereafter, which should tend to reduce the comparative costs. The total output to March 25 has been—

Aug. 1 to December	43,867	units.
December to March 25	34,359	"
Total	78,226	units.
The working cost of producing this has been	£1,774 = 5.44d.	per unit.
Proportion of interest only chargeable for this period	629 = 1.93	"
	£2,403 = 7.37d.	per unit.
Add if the whole interest and sinking fund for 8 months had been chargeable = £1,150, at 5¼ per cent	521 = 1.60	"
Total	£2,924 = 8.97d.	per unit.

The cost per unit sold is rather diffcult to apportion in this necessarily experimental period, owing to waste caused by trials of plant, and which are recorded in the output only, and might be misleading. The loss on distributing of the incandescent system alone is about 25 per cent. of the output; that for the arcs being almost negligible, owing to the mains being in use during the time of actual lighting only. This working cost is undoubtedly a high figure in comparison with the selling price, but as the plant has reached its maximum capacity, and the working cost has had the advantage of freedom from repairs, rates and depreciation, it is clear that any reduction on cost must be in the direction of longer average daily loads, coupled with sundry economies, and the very doubtful advantage of a larger station. I have not given a detailed cost of the 8 months' working, and think it more reliable to give later details now we are in fair working order, as being more accurate.

Table Showing the Working Cost for Several Weeks During April and May, which is the Period of Small Demand for Lighting, Excepting Whit-week, when, being Holiday Time, a Large Increase of Output is Requisite Here.

	No. 1 Week.		Units.	No. 2 Week.		Units.	No. 3 Week. Reserve Full Hourly Capacity.		Units.
Output			2,793	Output		2,424	Output		4,063
	Per Ct.	Units.		Per Ct.	Units.		Per Ct.	Units.	
Estimated loss in mains	16.4=	460		18.9=	460		13.5=	550	
Estimated loss in transformers	19.3=	540		22.2=	540		15.7=	639	
Used at works	3.7=	106		4.4=	108		2.6=	109	
Loss	39.4=	1,106	1,106	45.5=	1,108	1,108	31.8=	1,298	1,298
Accounted..	60.6		1,687	54.5		1,316	68.2		2,765
Estimated Revenue—			Units.			Units.			Units.
Metered incandescent			806	Incandesc'nt		481	Incandescent		1,829
Arcs, 54 } " 827 }			881	Arcs, 122.5 } " 713.0 }		835	Arcs 277 } " 659 }		936
Total			1,687	Total		1,316	Total		2,765
Coals Used—									
T. C. 29 5 = 38.8 lbs. per unit sold.				T. C. 29 5 = 49.8 lbs. per unit sold.			T. C. 31 12 = 32.6 lbs. per unit sold.		

Working Costs—				Per Unit Sold.				Per Unit Sold.				Per Unit Sold.
Coal	£13	9	9..	1.8d.	£14	15	3..	2.6d.	£14	16	9..	1.3d.
Oil and engine stores.	3	8	6..	0.4	4	5	3..	0.8	3	19	4..	0.3
Water	2	19	6..	0.4	2	17	0..	0.5	3	12	0..	0.3
Engineer	5	0	0..	0.7	5	0	0..	0.9	5	0	0..	0.4
Electrician	6	0	0..	0.8	5	13	6..	1.0	5	12	6..	0.4
Wages	10	5	7..	1.4	10	2	7..	1.8	11	3	3..	0.9
Repairs and Maint'n'ce.		—				—				—		
Works cost	£41	3	4..	5.8d.	£42	13	7..	7.7d.	£44	3	10..	3.8d.
Rates & taxes	1	12	0..	0.2	1	12	0..	0.2	1	12	0..	0.1
Insurance	0	2	6..	—	0	2	6..	0.01	0	2	6..	--
Office, lab. & general expenses	4	12	0..	0.6	4	12	0..	0.8	4	12	0..	0.4
Int. and sinking fund	31	0	0..	4.4	31	0	0..	5.6	31	0	0..	2.6
Total costs.	£78	9	10..	11.1d.	£80	0	0..	14.5d.	£81	10	4..	7.0d.

From these working costs, it is clear, in comparing week No. 3 with Nos. 1 and 2, that increased output for the heavy week caused decreased cost; and the net result for the year depends on the total output the plant is required to supply. It would require an average weekly output of 4,000 units, or 208,000 units per annum, to enable the works to sell electricity at 7d. per unit, which is the cost for week No. 3, when the whole plant was employed in producing 4,000 units. The amount earned at the prices charged, I think, need not concern you, as the cost price is the datum which ultimately fixes the commercial value in comparison with that of gas.

Having placed before you the result of the working, it remains to be seen what has been the effect on the gas consumption during the period when 78,200 units of electricity were made, or a sale of about 58,000 units; being the equivalent of 5,800,000 cubic feet of gas. Well, during this period there were sold 180 million cubic feet of gas, as against 150 millions the previous year, or an increase of about 30 millions; our increase being five times the sale of electricity sold during the same period. To say that the effect was ***nil*** is true in one respect only, for the output of gas has increased—owing partly to the addition of 300 new consumers and partly to the more general use of gas. Had there been no electricity works, I think we should have had about another million cubic feet of gas sold. Taking 30 of the largest consumers of electricity, and comparing their accounts with the corresponding March quarter of 1893, we arrive at the relative effect on old consumers they take up:

Thirty consumers used—	Cubic Ft. of Gas.		Electricity.
March quarter, 1893	2,936,000 at 2s. 6d. =	£366	— £366
" " 1894	2,360,000 at 2s. 6d. =	295	£396 691
Less used	576,000	Less	£72

So that for the £72 worth less gas used, they took £396 worth of electricity, making the total lighting account £691—against £366—being an increase of £325 for the quarter in their accounts.

To summarize, it is evident that, wherever electricity is used, less gas is burnt; and of the new customers hereafter it will take a share thereof. Electricity undoubtedly being a good light for business purposes, where its principal consumption lies, increased demand will continue until what is termed the "saturation" of the district is reached. The precise amount of this, one can hardly foresee, and I think there is undoubtedly room for both systems in most towns—the extent varying with the peculiarities of each. Hereafter, with a dual supply in operation, the gas industry will have to be satisfied with less than the whole loaf, so to speak—a slice being taken off by electricity; so that the general effect will be that a gas company will be relieved to some extent of that great increase which has yearly taken place in gas consumption.

Two Interesting Chemical Notes.

By Jos. W. Richards, Ph.D.

Specific Gravity of Some Fused Salts.—In the production of aluminium, as at present carried out, calcined alumina is dissolved in a bath of fused cryolite, or fluid cryolite plus aluminium fluoride, and an electric current passed through from carbon electrodes. Whatever are the reactions which take place whereby the aluminium is liberated, the final result is simply the liberation of aluminium at one pole and oxygen at the other, as long as the bath is kept supplied with all the alumina it can dis-

solve. The following train of thought suggested itself to the writer: If the specific gravity of aluminium is 2.7, and that of cryolite 3, how is it that molten cryolite floats on top of molten aluminium?

In order to get the specific gravity of the fused materials, a tight iron mould was taken and carefully measured. It was then filled level with the different molten salts, and from the weight of the salt and the computed volume of the mould, the specific gravity was calculated.

The following results were obtained:

	Specific Gravity.	
	Molten.	Cold After Fusion.
Commercial aluminium	2.54	2.66
Commercial cryolite from Greenland	2.08	2.92
Cryolite which contains all the alumina it can dissolve	2.35	2.90
Cryolite + aluminium fluoride added in such quantity as to make a salt of the formula Al_2F_6. $2NaF$	1.97	2.96
Same as above, but containing all the alumina it can dissolve	2.14	2.98

It can, therefore, be seen that while aluminium itself expands comparatively little in melting, the salts from which it is made expand from one-fifth to nearly one-third of their volume, and, therefore, while heavier than aluminium when cold, they are lighter than aluminium when molten.

An Instructive Case in Thermo-Chemistry.—The writer endeavored to decompose a solution of ferrous sulphate by boiling it with finely ground calcium carbonate, thinking that the following reaction might take place, precipitating the iron:

$$FeSO_4 + CaCO_3 = FeO + CaSO_4 + CO_2$$

The boiling was continued an hour, without a trace of ferrous oxide being precipitated.

The experiment was repeated with magnesium carbonate, thinking that the solubility of the magnesium sulphate might assist the reaction. The result, however, was similar to the first.

Thinking that possibly the decomposition would take place if the carbonic acid were first driven from the reagent by heat, the experiments were repeated with milk of lime and milk of magnesia. The precipitation of the iron was at once evident, showing that the expectation was correct.

Casting up the thermal data of the reactions involved, the figures show exactly why the reactions failed in the first instance and succeeded in the second.

$$FeSO_4.Aq + CaCO_3 = FeO.Aq + CaSO_4 + CO_2$$

Heats of formation.. 235,600 + 270,410 = 506,010 ; 68,280 + 320,040 + 96,960 = 485,280

Deficiency ..... 21,730 calories.

$$FeSO_4.Aq + MgCO_3 = FeO.Aq + MgSO_4.Aq + CO_2$$

Heats of formation.. 235,600 + 267,600 = 503,200 ; 68,280 + 322,580 + 96,960 = 487,820

Deficiency ..... 15,380 calories.

$$FeSO_4.Aq + CaO.Aq = FeO.Aq + CaSO_4$$

Heats of formation..... 235,600 + 149,460 = 385,060 ; 68,280 + 320,040 = 388,320

Excess..... 3,260 calories.

$$FeSO_4.Aq + MgO.Aq = FeO.Aq + MgSO_4.Aq$$

Heats of formation..... 235,600 + 148,690 = 384,560 ; 68,280 + 322,580 = 390,860

Excess..... 6,300 calories.

To find out why one has failed, and to predict where one may succeed, might be more frequently the office of thermo-chemistry, if better understood and more frequently applied.

Anthracite Coal in Bucks County, Pa.—The writer found, in 1892, a thin seam of anthracite coal at Hartmann's iron ore mine, 1½ miles south of Hellertown, on the Springtown Road. The Saucon Valley, in which this mine lies, is a limestone pocket, surrounded by the syenitic ridges of the South Mountain, which have a general trend of southwest to northeast. The mine occurs at the junction of the limestone and granite, at the foot of one of these ridges. The ore is argillaceous siderite. The coal is found in a seam about one-eighth to one-quarter of an inch in thickness, overlying the iron ore and imbedded in brown clay, which is somewhat indurated near to the coal. At the point where the specimens were dug out, the coal was within a few feet of the surface. Every indication pointed to it being a true occurrence, found *in situ*, as the clay bank out of which it was dug had apparently never been disturbed. The coal is true anthracite, burning before the blowpipe without any yellow flame to a reddish-brown ash.

Smoke-Preventing Appliances.

[Read by Mr. W. P. Sicard, before the Franklin Institute.]

The attention of the writer having lately been called to the subject of smoke prevention, and, becoming much interested in it, he has chosen this for the subject of a paper, thinking that it might interest the members of this section to discuss some of the devices proposed for this purpose.

While there seem to be an almost infinite number of devices for the prevention of smoke, many of them, if not nearly all, are practically untried. It is true that for nearly all the systems before the public, the inventors base their claims of efficiency upon the results of practical tests, but they are not always to be depended upon. It is by the results of continuous service, more than by special test that the merits of such an invention are proven, and it is usually the case that that system or device, for whatever purpose it may be, which is in the most general use is the best.

The question of the combustion of smoke, or, more properly, the prevention of smoke, is one of great interest to the engineer. The increased efficiency that will result from a more complete combustion of the fuel fed to a furnace, makes it an important object to scientific men to contrive some device whereby this end may satisfactorily be attained, and which, accordingly, must be simple, economical, durable and susceptible of regulation and control. That there are many inventors who claim to have solved this problem, the records of the Patent Office will attest, and doubtless many of them in a greater or less degree have done so, or at least have increased the efficiency of the particular boiler upon which they experimented.

There is such a vast difference, however, in the very foundations of their claims, and at the same time such a sameness in their results, and the methods of attaining those results, that one is almost bewildered. There are smoke preventers of every conceivable kind and variety, some of them simple, the greater number complex. There is no doubt that a cheap, simple and durable system that would give satisfactory results would be in demand, for in the fierce competition of these days every money-saving device must be employed. Of those at present on the market many are inefficient and practically untried. So many inventions are brought out before it has really been shown and proven that the results from their use are a gain or a loss, that manufacturers naturally hesitate before trying a new thing. Also, many of these systems are so exceedingly complex as almost to require the services of a man specially trained to operate them.

Smoke is defined for us as the combustible and uncombined products, produced in the imperfect combustion of coal, and which pass off from a furnace by way of the flues. Its principal constituents, and the only ones we need notice just now, are the portions of hydrogen and carbon of the fuel gases, that by reason of an insufficient supply of oxygen, have not been transformed into steam and carbonic acid, the ultimate products of the complete combustion of carbonaceous fuel. The hydrogen and partially burned carbon thus given off are invisible, but much of the carbon, when separated from the hydrogen in furnaces of faulty construction, changes from the gaseous to the solid state and becomes visible as a black, sooty body.

Coal is composed of a number of substances; the main constituents of all coal, however, are carbon and hydrogen, and these two in various combinations constitute the bituminous portion from which are derived the volatile products given off in the combustion of coal. The principal portion, however, is composed of carbon. The bituminous part of carbonaceous fuel becomes available for heating purposes only after its conversion to the gaseous state, while the carbonaceous portion is available in the solid state.

Carbon is susceptible of uniting with oxygen in two proportions, by which two distinct bodies, possessing distinct chemical properties, are formed. These bodies are carbonic oxide and carbonic acid. One of the most important facts revealed by the analysis of coal is the large proportion of hydrogen which bituminous coals contain. This may be roughly estimated at from 5 to 6 per cent., and it forms the main element of the evolved gases by the combustion of which flame is produced. Where coal is exposed to heat in a furnace the bituminous

portions are volatilized and pass off. At the lowest temperature various condensable hyrocarbons are evolved. At the highest temperatures of distillation, permanent hydrocarbon gases and hydrogen are given off. After this distilling process, all that remains in the furnace is the fixed or solid carbon of coal, called coke, and mixed with it, earthy matter, the ash of the coal. The fixed carbon or coke remaining in the furnace after the volatile portions of the coal are given off, averages about 60 per cent. of the gross weight of the coal. As stated before, the hydrocarbons given off at the lowest temperatures, being richest in carbon, constitute the flame-making element of the coal.

A charge of coal, thrown upon a furnace fire, does not increase the general temperature, but lowers it and generates gases. On account of the amount of heat that is converted from the sensible to the latent state in this process, volatilization is a cooling process. So long as the bituminous constituents of coal are being evolved in quantity, the carbonaceous portion remains comparatively cool and useless as a heating agent. In short, the carbonaceous part has to wait for the heat required for its combustion until after the bituminous portion has been consumed.

The ratio of heating effect in the perfect combustion of coal compared with that evolved in imperfect combustion may be stated as about 15 to 4.5. Carbonic oxide is the result of imperfect combustion, and carbonic acid the result of perfect combustion of carbon. Combustion means union; in other words, the union of a combustible body with a supporter of combustion, in this case oxygen. At this point it may be interesting to note that coal gas is not inflammable; for by itself it cannot produce flame or support combustion in other bodies. A lighted candle in an atmosphere of coal gas will be extinguished.

Effective combustion for practical purposes depends more upon the air than the gas. This is so because we cannot control the gases while we can control the air that we supply to the furnace, and it is this control of the air that is the foundation of nearly all smoke-preventing devices. A good example of the unburnt gases in a flame is afforded by the common candle. In this, the tallow is first melted, then drawn up through the wick, and changed to a vapor, which has its temperature raised high enough to cause it to combine with the oxygen of the air, the heat of the combustion causing the separated carbon particles to become heated to brilliant whiteness. Around the outside is a filmy flame of this vapor and in the middle of it is a portion of gas which cannot be burnt for want of oxygen, which has no chance to reach it. If we supply oxygen to this flame by means of a blow-pipe, we greatly increase its temperature. In furnaces with natural draught, the volume of air required exceeds that required when the draught is produced artificially; an insufficient supply of air causes imperfect combustion, though an excess in the supply of air means a waste of heat. With very slow and uniform rates of combustion, nearly all the air required may be drawn through the grate; but if the rate of combustion be high, a great part of the air must be fed to the fuel above the grate, to consume the gases generated.

There are numerous cases in which, while dense smoke is given off with the furnace door closed, if it be opened slightly a great improvement in this respect will be noticed. At the same time, it has been conclusively shown, in certain classes of boilers, that while in realizing the highest power of a gaseous coal smoke is prevented, yet, in realizing the highest power of the boiler, smoke is made. The proportion of surplus air, the presence of which is required for the combustion of coal in ordinary furnaces in excess of the quantity which is chemically consumed, is diminished as the rate of combustion is increased, and the diminution of this excess is one of the reasons why the temperature of the furnace rises as the rate of combustion increases. This is shown in the following tests, the figures being from four different tests of different boilers and coals:

	Coal per square foot of grate per hour.	Surplus air.
Test 1.....	2 to 4 pounds.	100 per cent.
Test 2.....	7 pounds.	100 per cent.
Test 3.....	10 to 16 pounds.	25 to 50 per cent.
Test 4.....	20 pounds and upwards.	9 per cent.

In ordinary practice the rate of combustion for anthracite coal is from 7 to 16 pounds, and for bituminous coal 10 to 12 pounds, and with artificial or forced draught with blower, exhaust blast or steam jet, the rate may be increased from 30 pounds to as high as 120 pounds. It has been shown that in the marine boiler from 20 to 32 per cent. of the total heat of combustion is expended in producing the chimney draught, and, if we add to this the losses which will result from incomplete combustion and dilution of gases by excess of air, it will bring the total loss up to nearly 60 per cent.

From the foregoing statements, which express the results of practical tests, we are led to the conclusion that the cardinal principle of all smoke-preventing devices is, that in order to achieve complete combustion, and thus prevent the formation of smoke, the gases produced and air supplied must promptly and thoroughly be mixed. We have spoken of the relative volume of air required in natural and forced draught, and also of the various rates of combustion. In regard to the place of admission, above the grate, it has been found by test that the admission of air at the bridge of the furnace gives about 2½ per cent. better results than when it is admitted at the front of the grate. If the grate be not equally well covered with coal, the air admitted will enter in irregular streams through the uncovered parts, and be restricted at the time when it will be most needed. Of course, under such conditions, it bids defiance to all control and regulation, and as all that we can do towards effecting perfect combustion depends upon regulating the supply of air, the importance of having the coal on the grate well and evenly distributed is evident. [To be concluded.]

"A Living Price" in Electrical Engineering.

Mr. Sidney F. Walker, in the *Electrical Review* (London) remarks:

While the whole world is resounding with the clamor raised by the working miner and his friends, in their efforts to secure what he considers to be "a living wage," it may not be amiss for electrical engineers to consider the, to them, equally important matter of securing a living price for their work.

Electrical engineering is considered, and with some reason, to be ***the*** profession of the future. It is the one profession not yet overcrowded, and it will probably be many years before there ceases to be room for those who know their work and like it.

But on the commercial side of the question the outlook is not always so rosy, even in what are termed good times. In fact, it is almost an open question whether so-called bad times are not better for ***bona fide*** electrical engineering businesses, so far as profits are concerned, than good times.

So few firms have yet learnt the important lesson that all electrical engineering businesses are very expensive to conduct successfully; and so the majority of firms compete against each other in the endeavor to secure business that can only involve them in loss.

It ought surely to be an axiom by now, that in any business the only fund from which all expenses, all wages, all interest and all profits are to be paid, is that formed by the profits on business done. In the case of electrical engineering, on installations completed, on sales made. And, if any business is to be successful, the rate of profit must be such, no matter how high it may seem, as will provide for all these items out of the annual turnover. Rents, taxes, gas, electric current, if used, stationery, stamps, telegrams, clerks, all have to be paid for. And you must advertise in some form or other if you are to secure business. It will be of no use dubbing yourself a manufacturer or contractor, and waiting for people to find it out. Not only must you let those you wish to be your clients know of your being established, but you must acquire their confidence. They must have a reasonable assurance that you are able to carry out your work before they will place work with you. And when you have arrived at the stage when you may obtain work if your price is favorable, more expense awaits you, in the shape of tenders to be prepared, possibly drawings to be made, etc.

Even when you have secured the work and carried it out your expenses do not cease. In many cases the users are new to the apparatus, and little accidents occur, sometimes little mischiefs, which you will do wisely to make good at your own cost; the expense is less than the loss of business that would be involved if you did not. Even now your expenses are not at an end. Perhaps a friendly rival approaches your customer and makes disparaging remarks on your work. Perhaps he does not make any remark, he only shakes his head or shrugs his shoulders. In either case the operation will lead to further expense on your part to remove the impression your friend has created. And even after that your expenses are not at an end. You have to collect the amounts of your several sales or contracts—sometimes an expensive matter—and you have to keep an accurate record of all your transactions; of your sales, of your wages, of your purchases, what your contracts cost you, and so on. It will be said, no doubt, and with perfect truth, that all this is common to every engineering business. What the writer wishes to point out is, that while they are supposed to fall more lightly on an electrical engineering business, in practice they fall far more heavily. The very nearness of everything, the elements of uncertainty and of risk, all tend to increase the working expenses.

And the danger of this is so much greater because unseen. Engineers young to business, and those outside of the business entirely,

are often unable to see why certain expenses should be incurred; and it is only sharp experience that teaches them, they meanwhile living in a fool's paradise, thinking how very well they are doing, while the older firms they are trying to displace are merely waiting till the inevitable awakening comes.

And so it may well turn out that in order to show an actual profit on the year's trading, your apparent profit may look very large indeed. Your young rival, for instance, who was, perhaps, lately on the staff of some other firm, calls it positively iniquitous; yet it represents to the electrical engineer in business, or to the shareholder in an electrical engineering company, a *living price* as truly, far more truly, than does the sum the working miner is claiming as a living wage. And if this is so, is not the cutting of prices that is so constantly going on, not only foolish but wrong?

Do not directors and managers of electrical engineering companies who sell below this living price, except under dire necessity, betray the trust reposed in them as truly as if they gave their companies' money away? And is not every private firm who does the same similarly guilty to those who are dependent on them, inasmuch as it can only lead to financial disaster?

And yet look at what has been done in the past. To take an instance, when the Edison-Swan Company allowed a discount on their lamps proportional to the sales, and so arranged that both large and small traders could secure a fair profit, what happened? The consumer was actually offered these lamps at a lower price than the largest buyer could purchase them for. And to-day there is the same foolish rush for the honor of supplying goods at less than cost, and yet out of this minus quantity must come all the expenses detailed above.

There are, of course, cases where firms tender for one thing and supply another, but the consideration of business of that kind hardly falls within the scope of this article. It meets its own reward, and usually at no distant date.

But if we look on the other side of the picture and ask who have been the successful firms, it will be found that the firms who have stood as electrical engineering has advanced have been few; but they have all been marked by the same characteristics.

Their work has been the best that the knowledge and experience at the time could produce, and they have usually followed their work to insure its success. This is often a source of very considerable expense.

They have kept steadily before them the fact that unless they secured, in the main, a living price, they could not go on advancing, they could not go on at all, and they have insisted on having their price.

They have been free from all the tricks so common to firms who wish to secure business at any price.

Their motto appears to have been, "We cannot afford to lose, and we cannot afford to do bad work."

The writer does not wish to be misunderstood. There are times when it is perfectly legitimate to lower prices; there are times even when prices *must* be lowered, even to a very low margin over cost.

There may be times even when it is not only legitimate, but absolutely necessary to sell under cost. But these times should be rare, they should be the exception, and they should only be allowed under dire necessity.

In conclusion, the writer trusts that none of the readers of this article will imagine that he wishes in any way to put the dial of progress back. It would be impossible for him to do so. But he trusts also that none of them will imagine that mere cheapness will accelerate the progress of the advance of electricity, or that its advance will be retarded by the insistence upon the receipt of a living price for their work.

Whatever may be the commercial course in the future, whether marked by the unhealthy signs that have been so manifest in the past, or by the stronger, safer and more manly status involved in a living price, the advance of electricity must and will go on, like the advance of civilization itself, crushing out of existence all that opposes its progress, and crushing first the weaklings who are afraid to stand by and guide it.

Electric Machine for the Mechanical Copying of Sculpture.

An Austrian contemporary says that although the artist's hand and eye are indispensable to the perfection of a work of sculptured art, mechanical appliances are extensively used in the rough-hewing of massive figures; and, recently, a machine has been invented in France capable of producing copies of existing sculptures without calling for any great artistic skill in the workman. The copies can be either enlarged or reduced, and although the present machine is designed to turn out unfinished work only, its productions are so geometrically exact that it cannot fail to find an extended application for the copying of sacred and monumental figures, of which great numbers are in demand. This cleverly designed machine is driven by electricity, and consists of a framework of two vertical pillars connected above by a transverse iron beam, through the middle of which a revolving spindle descends vertically to a spur in the foot plate. On this spindle there glides a nut with a horizontal plate extending to both sides. The original sculpture is placed between the spindle and the pillar on the right, standing vertically on a plate on the bottom. The stone to be worked occupies a similar position between the spindle and the pillar on the left. On the nut-attached plates above mentioned there is fixed on the right, close to the original sculpture, a peculiarly constructed instrument resembling a pantograph, to which is attached a pencil which is guided over the contour of the sculpture to be copied. The latter revolves on its vertical axis on its footplate, while by the mechanical revolution of the spindle the support with the pantograph sinks slowly; by these means every portion of the surface of the original is brought into contact with the point of the sensitive pencil of the pantograph. This pantograph is in electric connection with a pantograph on the left support near the block of stone to be operated on, and by electric agency the second pantograph reproduces all the movements of the pantograph on the right, in increased or diminished measure, according to the resistance. The instrument contains a small motor, which communicates a revolving motion to the pencil, acting as a cutter, in contact with the stone block, so that, in this way, corresponding to the movement of the sensitive pencil of the pantograph on the right, a figure is produced which is a geometrically exact copy of the original figure on the right. If it is designed to reduce the size, the figure is revolved more rapidly while the pantograph with the cutter sinks more slowly. As before said, the figure thus produced is not perfect in the finer details and has to be finished by hand, but the invention secures great economy of labor while producing an exact copy.

United States Iron Production in 1894.

The *Engineering and Mining Journal* states that the report of the American Iron and Steel Association for the half year ending June 30, which is based on the returns received from the members of the Association, gives the production of pig iron in the United States for that period at 2,717,983 long tons, an amount from which our own estimate made from week to week differs by only 6.6 per cent.; a very close approximation for a period of such constant fluctuation in output as the half year was. Of the total output 412,047 tons was supplied by the anthracite furnaces, 102,697 tons by the charcoal furnaces, the remaining 2,203,239 tons being coke iron. Of the total product also it may be noted that 1,501,487 tons are classed as Bessemer pig.

This output shows the large decrease of 1,844,935 tons as compared with the first half of 1893; but on the other hand there was an increase over the second half of last year of 156,399 tons, which would doubtless have been greater but for the interruptions to blast furnace work caused by the coal miners' strike and the railroad strikes, which not only prevented furnaces from starting up, but forced many of those in blast to close down.

For the 12 months covering the period of depression in trade—that is, from July 1, 1893, to June 30, 1894—the output of pig iron was 5,279,567 tons, this being about 58 per cent. of the production of the calendar year 1892. Taking the two half years together, the output was less than in any year since 1885. That there should have been an increase this year, in spite of the special reasons against it, is an encouraging fact.

The stocks of pig iron in makers' control on June 30th were not large. They amounted to 517,036 tons, and were 145,032 tons less than on January 1st. As the stocks on that date exceeded those on June 30th, 1893, by 112,923 tons, it appears that the actual consumption of pig iron in the first half of 1894 has been approximately 414,000 tons greater than in the second half of 1893.

The production of Bessemer steel has followed nearly the same course as that of pig iron. For the first half of this year it was 1,667,454 long tons, showing a decrease of 424,603 tons as compared with the corresponding half of last year, but an increase of 543,825 tons over the second half of the year. The steel makers have been more active than the furnace men, and have made more advance this year. The rail production decreased in a greater proportion; but it must be remembered that the rail output is becoming each year a less important factor in the steel trade, as the applications and uses of steel are more extended.

Upon the whole, the report is more encouraging and shows a better condition than might have been expected. We have made substantial progress this year, and the close of the year will see the iron trade still further advanced on its return to a full measure of prosperity.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the St. Paul (Minn.) Gas Light Company have issued the following notice: "On and after September 1st, 1894, the price of gas will be $1.75 per 1,000 cubic feet, with a discount of 25 cents per 1,000 on all bills paid within 10 days after due. This reduction in price is made in accordance with our agreement with the Chamber of Commerce, and in this connection we respectfully call the attention of the public to the fact that this Company has steadily reduced the net price of gas from $7.50 per 1,000 to $1.50 per 1,000, the net price as late as 1886 being $2.50 per 1,000. We mention these facts only as an earnest of future early reductions."

THE proprietors of the Stamford (Conn.) Gas and Electric Company have authorized the United Gas Improvement Company to construct for them a standard, double superheater Lowe type of water gas machine, which apparatus will replace the Jerzmanowski or "baby process" water gas plant installed at Stamford some years ago. Mr. Purinton, who is now in charge at Stamford, is satisfied that the substitution will result in a considerable saving to the Stamford Company. Work on the contract is now underway, and the builders promise to have the same completed at an early date.

IT is likely that the gas works at Mount Holly, N. J., will soon change hands. A sensible business management—that is, one less inclined to conservatism than the one which has dominated the Company for many years—could largely increase the output at that place.

THE Board of Public Works, of Detroit, Mich., have finally agreed upon an official gas inspector (the determination to appoint one, together with a description of his duties, having been given in a former number of the JOURNAL) in the person of Charles Krecke. Krecke, who was a printer, assumed his new responsibilities on the 1st inst.

ON the 1st inst., the electric lighting supply of Ukiah, Cal., was discontinued. The plant will be dismantled and its parts removed to San Francisco, there to be offered for sale.

THE proprietors of the Plainfield (N. J.) Gas Light Company are considering the advisability of ordering a reduction in the selling rates.

WE regret to announce the death of Mrs. H. H. White, the estimable wife of the Superintendent of the Portsmouth (Va.) Gas Company, whose demise occurred on the evening of July 27th. Deceased was a niece of Mr. Edward Abend, President of the Belleville (Ills.) Gas Light Company.

THE absorption of the Rahway (N. J.) Gas Light Company by the Elizabethtown Gas Company, of which the Hon. John Kean, Jr., is President, is announced. Mr. Kean succeeded in purchasing the Shotwell interest in the Rahway Company, which interest amounted to about 56 per cent. of the capital stock outstanding, and the present owner proposes to shut down the Rahway plant and to supply that city with gas from the Elizabeth works. In connecting the main systems of the two places the line will pass through Linden, which village will thus be enabled to secure gas light for the first time in its history. It ought to afford the Company quite a number of consumers.

AT the semi-annual meeting of the Fitchburg (Mass.) Gas and Electric Company the following officers were chosen: Rodney Wallace, C. T. Crocker, H. I. Wallace, F. B. Shepley, C. E. Ware, Jr., H. T. Page and G. E. Clifford; President, Rodney Wallace; Treasurer and Superintendent, H. F. Coggshall.

FROM the annual report of J. E. Gannon (for year ended June 30th) official Gas Inspector for San Francisco, we learn that the following sums were paid to the named Companies on account of public lighting: San Francisco Gas Light Company, $214,957; Pacific Gas Improvement Company, $23,467; Pacific Lighting Company, $24; Edison Light and Power Company, $79,624.

IN the suit of the Roxbury Gas Light Company against the Brookline Gas Company, of Boston, Mass., Judge Hammond denied the petition of the complainant Company asking for injunctions to restrain the defendant Company from laying mains and supplying consumers in the Roxbury district, which is a victory for the Brookline Company. Questions raised by the demurrer will probably go before the full bench.

ACCORDING to advices, about a fortnight ago at a special town meeting of the citizens of Wakefield, Mass, the town voted to issue bonds in the sum of $180,000 for the payment of the purchase money involved in the acquirement on public account of the Citizen's Gas Company's gas and electric lighting plants. The town pays $144,000 for the plant, and the remaining $36,000 of the issue will be expended for betterments. The bonds are to be issued on October 1st, and the town voted to pay the principal in yearly instalments, as follows: For the first 10 years, $3,000 a year; for the next 10 years, $6,000 a year; for the following 10 years, $9,000 a year. The interest is to be paid semi-annually. This method of payment does away with the election of Sinking Fund Commissioners, which were provided for in the warrant. The following municipal light board was elected: Silas W. Flint, for 3 years; C. H. Spencer, for 2 years; Elroy N. Heath, for 1 year. The town will not come into possession of the plant until next October, when the bonds are to be issued. The vote on issuing the bonds stood 89 to 9.

MR. C. F. CLAFLIN has been elected President of the Milford (Mass.) Gas Light Company.

THE Directors of the Westfield (Mass.) Gas Light Company have decided to increase the capital stock to $75,000.

THE Albany *Argus* says that the United Gas and Electric Light Company, of Saratoga Springs, formed to furnish light and power for the streets, public buildings and residences of Saratoga, has been incorporated, with a capital of $60,000. The Directors named are Messrs. C. E. Arnold, of Albany, and E. J. Slattery and E. H. Peters, of Saratoga Springs.

THE employees of service division No. 6 of the Brookline (Mass.) Gas Company recently surprised their foreman, Mr. John Doherty, by presenting him with a handsome watch and chain.

ASHTABULA, Ohio, some time ago expended $66,000 in the construction of a municipal electric lighting plant, which it was guaranteed by advocates thereof would save the city at least 50 per cent. of the sum which it had been paying to an ordinary commercial institution for street lighting. Last year the cost of operating the plant was about $10,000, whereas the same service for the last year during which the work was performed by the "ordinary corporation" was a trifle over $8,000. The authorities are "investigating" the matter.

THE gas plant at the State Reformatory, Concord, Mass., which was destroyed by fire last September, is to be reconstructed or restored.

AN agitation for the reduction of the gas rate at Bradford, Pa., is going on. In fact, the citizens are clamoring for an ordinance to bond the city to raise a fund for the erection of a works to be operated on municipal account.

THE Selectmen of Spencer, Mass., have contracted with the Spencer Gas and Electric Light Company for a certain number of arc lights at the rate of 27½ cents per light per night, the understanding being that the lights shall be maintained during at least 240 nights of the year.

THE Hon. John C. Moulton, of Laconia, N. H., died at his home in that city on the 23d of July. He was for years connected with the old Laconia Gas Company, and was interested in almost every business enterprise of moment in that town. He was in his 85th year.

THE Chester (Pa.) *Times* says that extensive improvements, which will greatly increase the efficiency and capacity of the Media (Pa.) gas works are now going on. Among other things, a 10,000 gallon oil tank will be constructed.

THE board of arbitrators appointed by the city of Minneapolis to name a reasonable rate for gas to be charged by the Minneapolis Gas Company, were not unanimous in their findings. We are not able to give the exact figures proposed by the majority, but believe they suggested $1.40 as about the right thing.

THE Western Gas Construction Company, of Fort Wayne, Ind., has good reason for self congratulation over the fact that, despite the long continued stagnation in manufacturing industries of almost every nature, it has received a fair share of orders and at prices which are not altogether devoid of profit. The Company is now building for the Nanticoke (Pa.) Gas Company an entire new 8-inch works, the generating apparatus to be of the Western Company's improved Lowe water gas type, and the apparatus is calculated to a daily make of 125,000 cubic feet. The builders are also to furnish the incidental equipment of iron

roof and floor, an elevator and a horizontal boiler, with full front and setting. The purifying house is to be equipped with three purifiers, 8 ft. by 10 ft. by 4 ft., supported on girders which provide an unobstructed cellar for revivifying the fouled material. The boxes, which are to have 8-inch connections, will be operated by means of the Western Company's patented center-seal, which apparatus makes easy the manipulation of any desired number of boxes. The storage holder is rated to contain 30,000 cubic feet, and a street main governor, with bye-pass complete, is included in the specifications. The Western Company will also furnish all the street main specials, valves, etc., and the buildings are being constructed from designs and specifications prepared by the contractors. The plant will be a model one in every respect, and it is noteworthy that the proprietors of the Nanticoke Gas Company must have faith in the ability of good gas to readily compete with electric lighting, for whereas electric illumination is an old story with the residents of Nanticoke, they have yet to acquire practical experience with gas lighting.

THE Western Construction Company is also at work on the contract awarded it by the Phœnix Gas Light and Fuel Company, of Phœnixville, Pa., for the new plant which the latter has decided to construct. The contract calls for a set of the Western Company's improved Lowe water gas apparatus of 125,000 cubic feet daily capacity, and includes a boiler, iron floor, elevator, etc.; also two 8 ft. by 12 ft. by 4 ft. purifiers complete, the same to be operated, as in the Nanticoke instance, by the Western Company's patent center-seal. The purifying house is arranged to add two purifying boxes when the output reaches the high water mark. The contractors will also erect a storage holder rated to contain 75,000 cubic feet, the same to rest in a steel tank. The contract also calls for the construction of an oil storage tank of ample dimension, and the agreement is that the plant shall be completed before November 1st.

So many itinerant "meter inspectors" are at present plying their unlawful calling in this State, that perhaps the following digest of the State laws bearing on the question may be useful: The statutes provide for the appointment by the Governor of a State inspector (who resides in New York City) and for the appointment of deputy inspectors. Every meter put in use must be inspected, sealed and stamped by the chief inspector. The statutes also provide that gas companies shall keep a suitable apparatus, approved and certified to by the chief inspector, to test the accuracy of the meters installed by the companies; and it is also provided that every meter shall be tested on the written request of the consumer to whom the same shall be furnished, and in his presence, if the consumer desires it. If such inspection is not satisfactory to the consumer, by serving a written notice upon the company he may have his meter re-inspected by the State inspector, whereupon, if the meter shall be found defective to the prejudice of the consumer, the test shall be made without cost to the latter, but if the meter does not register against him, he shall stand the cost. The statutes clearly prohibit any unauthorized interference with the meters belonging to a gas company. The meters are the property of the company, and the penal code provides that any person other than a State inspector, or deputy inspector, or an employee of the company owning the meter, who shall detach or disconnect such meter, or make any test of or examine, for the purpose of testing any such meter so detached or disconnected, is guilty of a misdemeanor. If, as said before, any consumer is dissatisfied with the working of his meter, it is his privilege to apply to the company for an inspection of his meter under the provisions of the statute; and if that is not satisfactory he can insist upon an inspection by the State inspector. Eminent legal authority can be quoted for the opinion that any person who disconnects a gas meter for the purpose of making such a test without the authority of the company owning the meter, or from the State inspector of meters, may be criminally prosecuted for the act.

THE United Gas Improvement Company, as lessees of the works supplying gas in Jersey City, N. J., have given notice that on and after September 1st the net selling rate is to be $1.50 per 1,000 cubic feet.

MR. W. H. TUCKER, Inspector of Street Lighting and Services for the San Francisco and Pacific Gas Improvement Companies, of San Francisco, Cal., notified the plumbers and gasfitters of that city from August 1st, 1894, the mercury testing gauge would have to be used in testing gas piping, and that under no circumstances would the use of the spring gauge be allowed.

THE Central Trust Company, of New York, as trustee for the bondholders has begun an action in the Supreme Court to foreclose a mortgage on the property of the Standard Gas and Electric Company, of Suffolk county, L. I. The defendant issued bonds to the extent of $30,000, and John B. Archer, of Washington, D. C., who was interested in the contract for the construction of the works, and who has a lien on them for over $9,000, applied to Justice Bartlett, of the Supreme Court, for an order permitting him to examine W. D. B. James, President of the Standard Company, and Charles F. Street, of Street, Wykes & Co., of Wall street, New York, as parties before trial. Archer wanted to know the circumstances under which the Company issued the bonds, the consideration given for them and the dates of issue. Justice Bartlett denied the motion.

MRS. SUSAN SCHATT, on July 30th, began suit in the Philadelphia Common Pleas Court to recover damages for injuries received by her husband that resulted in his death at the residence of Joseph H. Schenck. On September 23d, 1893, Schatt was employed by Schenck to repair leaks in a machine for generating gas from gasoline. Plaintiff says that while her husband was repairing the machine Schenck carelessly opened a valve and large quantities of gasoline escaped, saturating the clothing of both men. Then, she says, Schenck walked directly toward the firepot used by Schatt, and a violent explosion followed, in which Schatt was so badly injured that he died from the wounds incurred.

THE Kansas City (Mo.) *Star* says: "On July 27th Alderman Brown introduced in the lower branch of the Kansas City Council a joint resolution asking the City Counselor to begin proceedings in the Circuit Court to annul two franchises granted by the Council years ago and later repealed by it. One franchise was granted to L. F. Wilson, Felix G. Fox and Joseph Monheimer, by an ordinance approved January 4, 1881, the other having been granted on February 3, 1886, to Henry McGurren and Michael W. Ryan. Both of these franchises, which the city wants the Court to adjudge and decree to be void, are said to be owned by the Kansas City Gas Light and Coke Company, and the introduction of the concurrent resolution is expected to result in opening the gas war at once. The Gas Company, whose present franchise will expire in February, 1895, will probably fight the movement on the part of the city to have the franchises declared void. Should this mode of procedure be adopted, Mr. John C. Gage, a member of the Board of Public Works, and one of the counsel for the city in the water works case, may come to the front in a new role, as he is one of the attorneys for the Kansas City Gas Light and Coke Company. The franchise granted to McGurren and Ryan in 1886 is said to have come into the possession of the Gas Light and Coke Company in this way. McGurren, who is again an applicant for a gas franchise in Kansas City, claims to have sold out to Ryan. The latter in turn sold the franchise to a Philadelphia attorney, who was one of the counsel for a Philadelphia Gas Company, and he subsequently notified the city that all titles and rights under the franchise were vested in him. As the Philadelphia concern is said to be largely interested in the Kansas City Gas Light and Coke Company, complications are expected when the city gets into Court with Ald. Brown's concurrent resolution. No work was attempted under the McGurren-Ryan franchise. The other Company started digging in the streets and was enjoined by the Kansas City Gas Light and Coke Company, and the Supreme Court sustained the injunction, holding that the franchise held by the complainant under the act of the State Legislature was an exclusive one. It was admitted at the time that the digging up of the streets and the injunction which followed were component parts of a 'bluff,' as the Kansas City Gas Light and Coke Company was said to control the stock of the defendant Company."

SOME days ago the Street Light Committee of the San Francisco Board of Supervisors renewed the discussion respecting the passage of an ordinance compelling the local gas companies to reduce the gas rate, the general opinion being that $1.85 per 1,000 would be a reasonable price, as against the ruling figure of $2. The chief spokesman on the score of reduction was Supervisor Hinton, who, in the course of a very ill-tempered speech, asserted that the rate in New York city had recently been reduced to $1 per 1,000. The balance of his argument was equally untrustworthy. Mr. Crockett, of the San Francisco Gas Company, presented the Companies' side of the case, and the matter was finally taken under advisement pending the filing of certain statistics by which Mr. Hinton hopes to prove that the charge for gas in San Francisco is exorbitant.

IN the reorganization of the Lockport (N. Y.) Gas and Electric Light Company the local interests will be represented on the Board of Directors by Messrs. H. J. Chadwick, E. M. Ashley, A. H. Ivins and S. C. Lewis.

ELSEWHERE we report the names of the officers chosen at the last annual meeting of the Fitchburg (Mass.) Gas and Electric Company, and to it we might add that the Hon. Rodney Wallace, who was chosen President, had acted in that capacity for 30 consecutive years. Mr. Coggshall, however, leads his chief in respect of length of service, since he has been the General Manager of the Company since its incorporation in 1853, and he has also been its Treasurer and Clerk since 1866. Mr. F. D. Page is the efficient Assistant Superintendent of the Company.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, AUGUST 6, 1894.

The Market for Gas Securities.

The expected break in Consolidated came last week, and there is no doubt that it came with a rush. The low point reached was 111, from which there was a substantial recovery to 118¼, the bid price at the opening to-day, Friday. The "scare" was likely caused by the offering of a block of stock which had long been held for investment account, and which stood the holders something less than 85. By the way, it is rather queer how quick the salaried officials of some of our financial institutions are to give out information respecting stock transfers. As we have said, since the adjournment of the Legislature, keeping in mind the wretched squabble going on in Brooklyn, the rate in New York City cannot be much longer kept at $1.25, and to this way of thinking we are not one whit influenced by anything that the East River Company may accomplish. Even at the $1 rate the Consolidated Company can with ease pay 6 per cent. on its capital, and we believe it is a purchase at anything under 120. Other city shares are fairly strong. We note a sale at auction of 5 shares Standard preferred, at 80. There is only one thing to say about the Brooklyn situation, and that is to advise a sale of the entire list, for prudent people will best be served by keeping aloof from Companies which are evidently operated on personal account. Chicago gas is dull and lower, at 72¼ to 73, and we advise its purchase at anything under 75. Baltimore Consolidated shows no change. At auction, 3,000 Equitable (Chicago) first mortgage 6's, at 95½.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

AUGUST 6.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	118¼	120
Central	500,000	50	100	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	185	187
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	150	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	25	30
Preferred	5,000,000	100	80	—
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	103	107
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	—	126
" Bonds	300,000		103	—
Peoples	1,000,000	10	—	70
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	—	136
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	—	155
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	135	140
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	12	13
Income Bonds	2,000,000	1000	60	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	78	—
2d " " "	3,000,000	1000	57	58
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	160	—
Chicago Gas Company.	25,000,000	100	72¼	73
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	54	57
Bonds	600,000	1000	92	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal.			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	65	65½
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds			60	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	89¼	—
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	17	—
Preferred "	2,500,000	100	69	—
Bonds	9,034,400	1000	87	88
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn		25	200	—
Oakland, Cal.			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	590,000	—	175	185
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71	71½
Washington, D. C.	2,000,000	20	240	—
Wilmington, Del.	500,000	50	180	182

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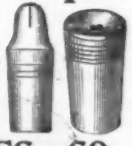

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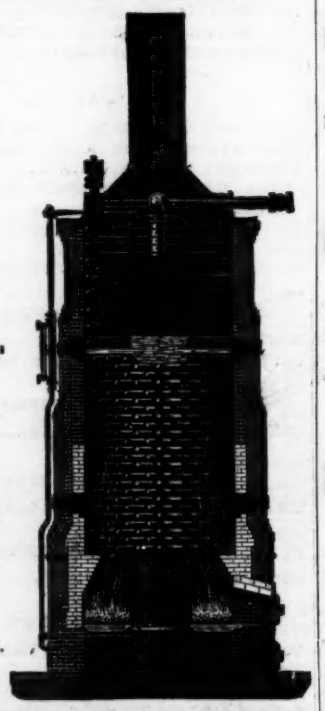

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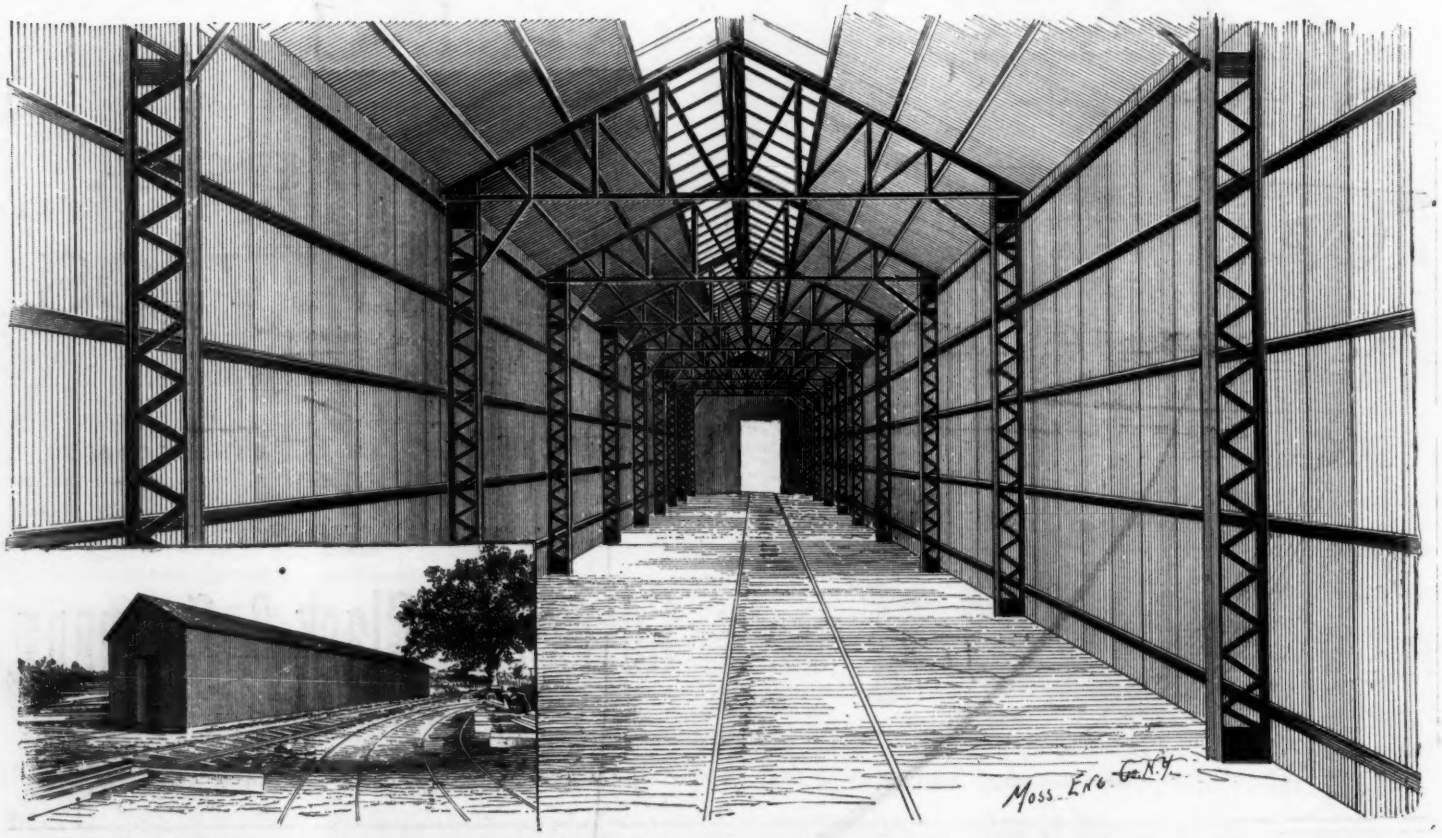

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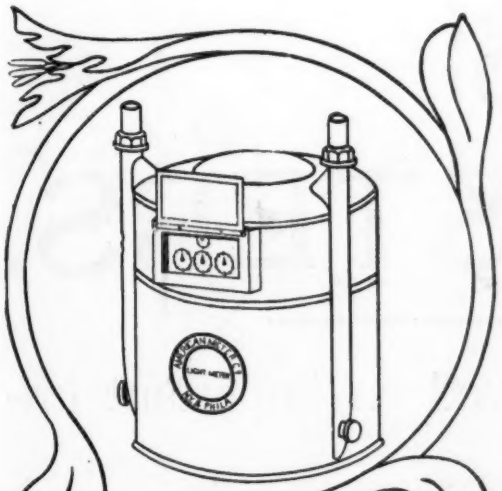

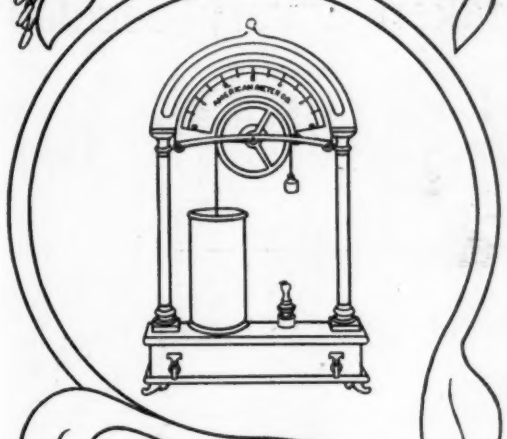

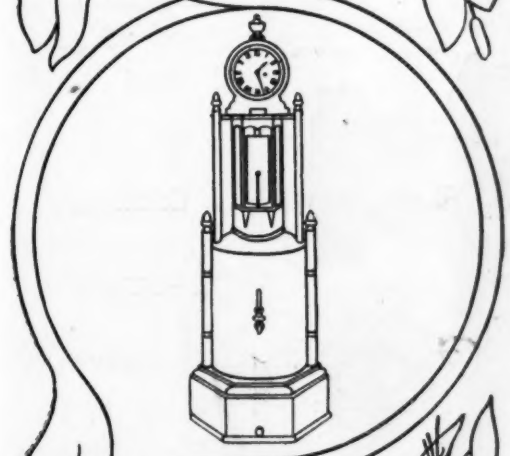

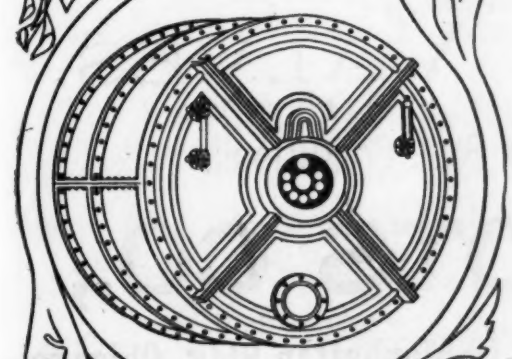

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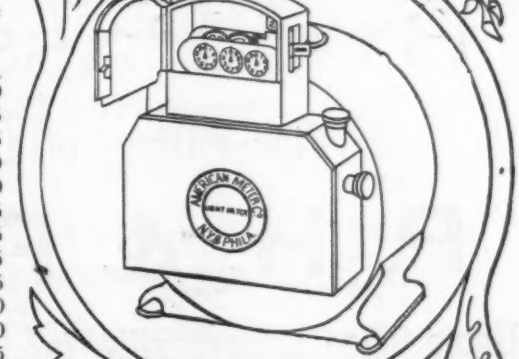
PUBLIC LIGHTING TABLE.

AUGUST, 1894.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	7.40 PM NM	4.00 AM	7.10	3.30
Thu.	2	7.40	4.00	7.10	3.30
Fri.	3	7.40	4.00	7.10	3.30
Sat.	4	7.40	4.00	7.10	3.30
Sun.	5	7.40	4.00	7.10	3.30
Mon.	6	9.00	4.00	7.10	3.45
Tue.	7	9.20	4.00	7.10	3.45
Wed.	8	9.50 FQ	4.00	7.10	3.45
Thu.	9	10.30	4.10	7.10	3.45
Fri.	10	11.10	4.10	7.10	3.45
Sat.	11	12.00	4.10	7.10	3.45
Sun.	12	12.50 AM	4.10	7.10	3.45
Mon.	13	1.50	4.10	6.55	4.00
Tue.	14	3.00	4.10	6.55	4.00
Wed.	15	No L.	No L.	6.55	4.00
Thu.	16	No L. FM	No L.	6.55	4.00
Fri.	17	No L.	No L.	6.55	4.00
Sat.	18	7.20 PM	9.00 PM	6.55	4.00
Sun.	19	7.20	9.20	6.55	4.00
Mon.	20	7.20	9.40	6.45	4.10
Tue.	21	7.20	10.00	6.45	4.10
Wed.	22	7.20	10.30	6.45	4.10
Thu.	23	7.20	11.10	6.45	4.10
Fri.	24	7.10 LQ	11.50	6.45	4.10
Sat.	25	7.10	12.50 AM	6.45	4.10
Sun.	26	7.10	1.50	6.45	4.10
Mon.	27	7.10	4.20	6.30	4.20
Tue.	28	7.10	4.20	6.30	4.20
Wed.	29	7.10	4.30	6.30	4.20
Thu.	30	7.10 NM	4.30	6.30	4.20
Fri.	31	7.00	4.30	6.30	4.20

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Totai	2274.20	Total	3987.45



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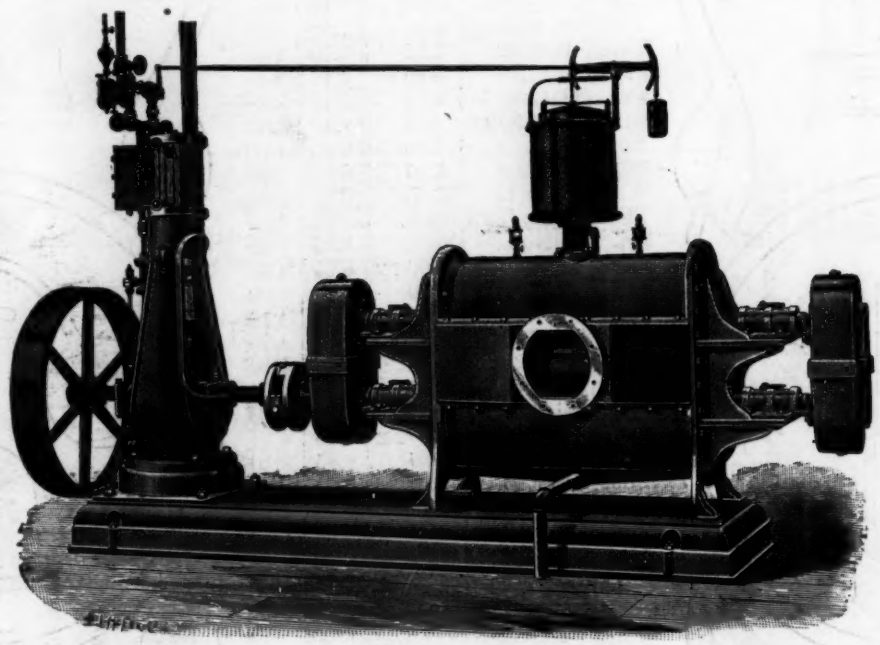

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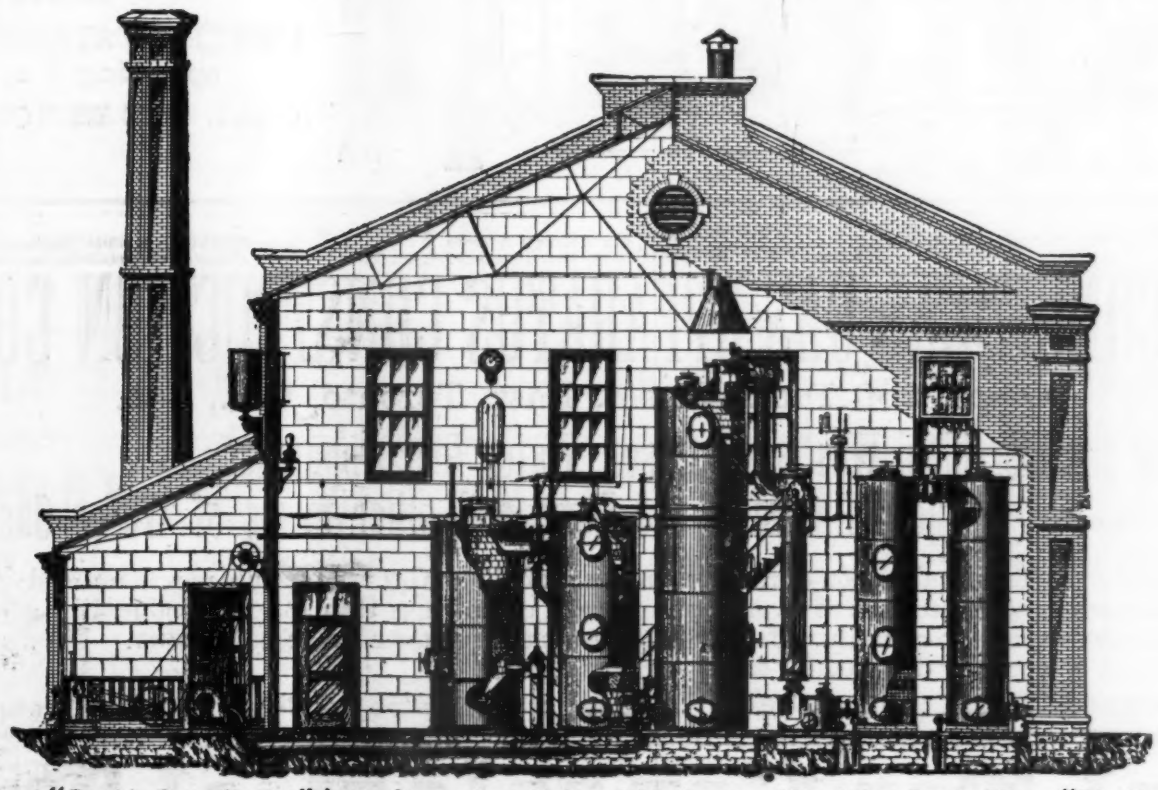

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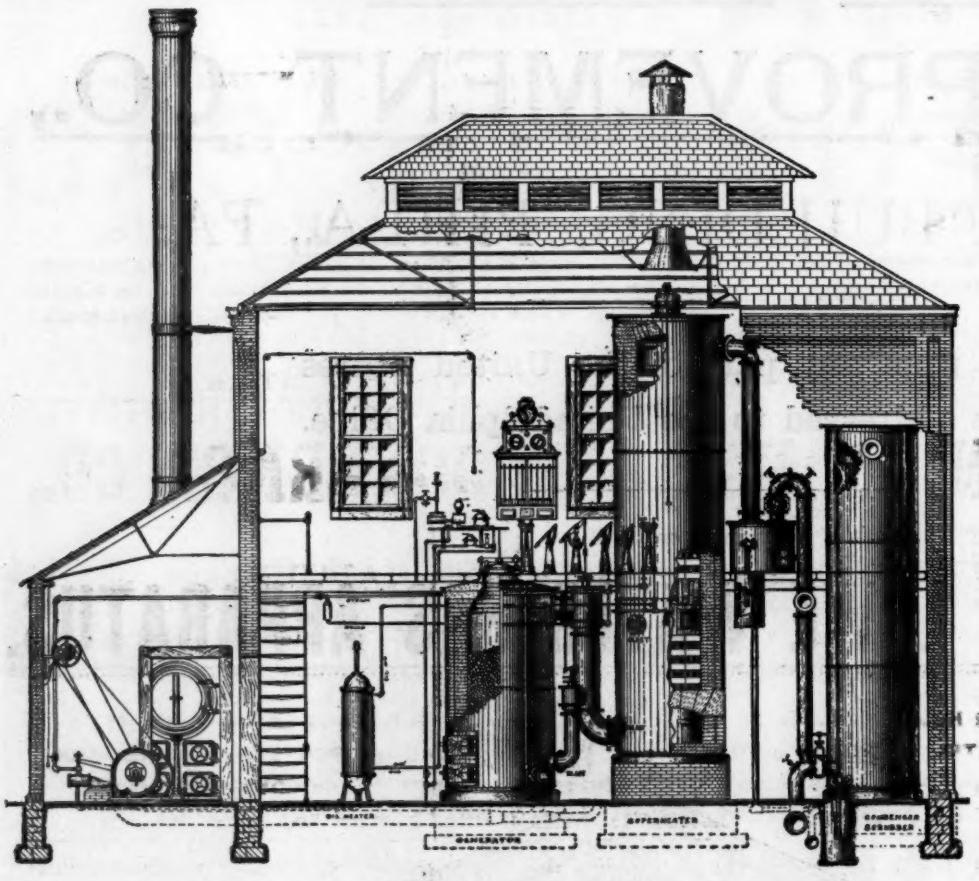

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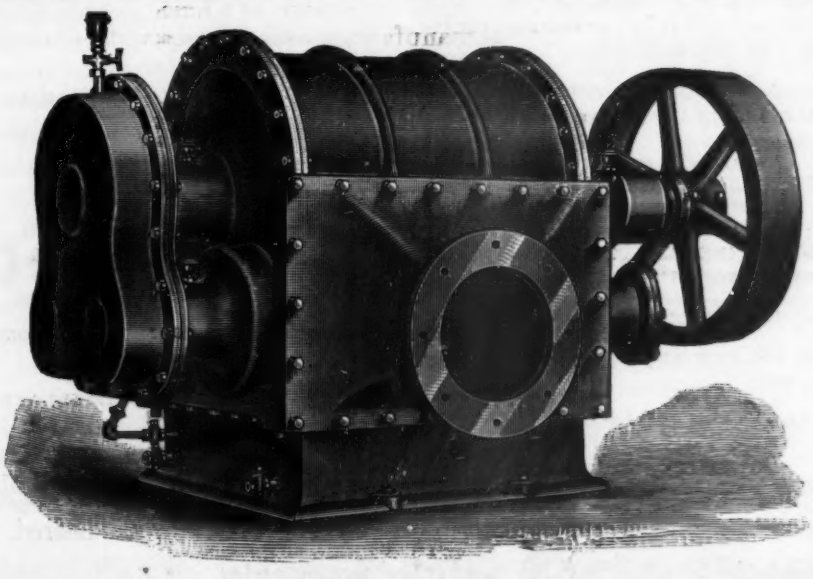

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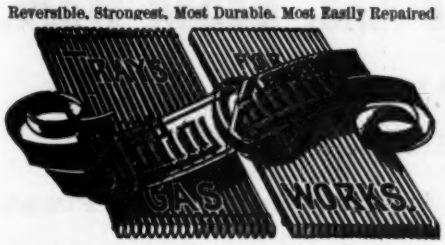

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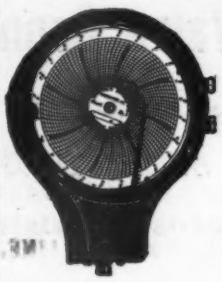

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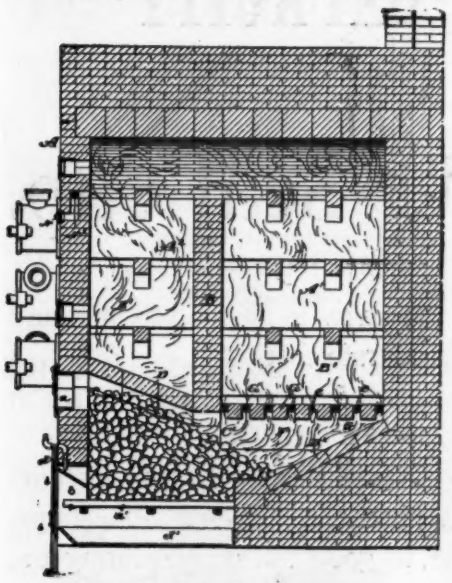

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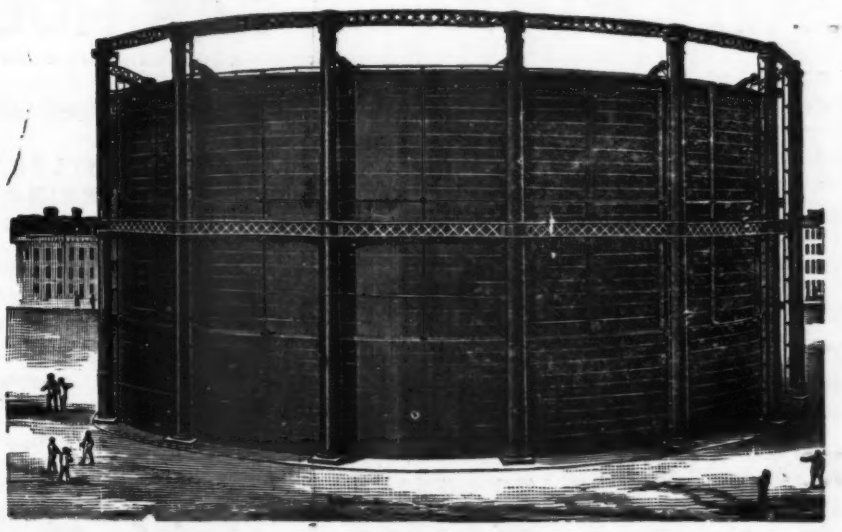

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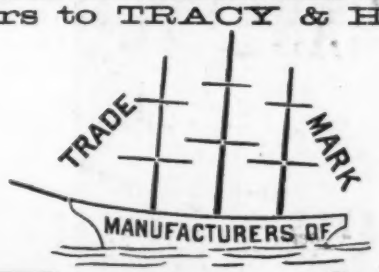

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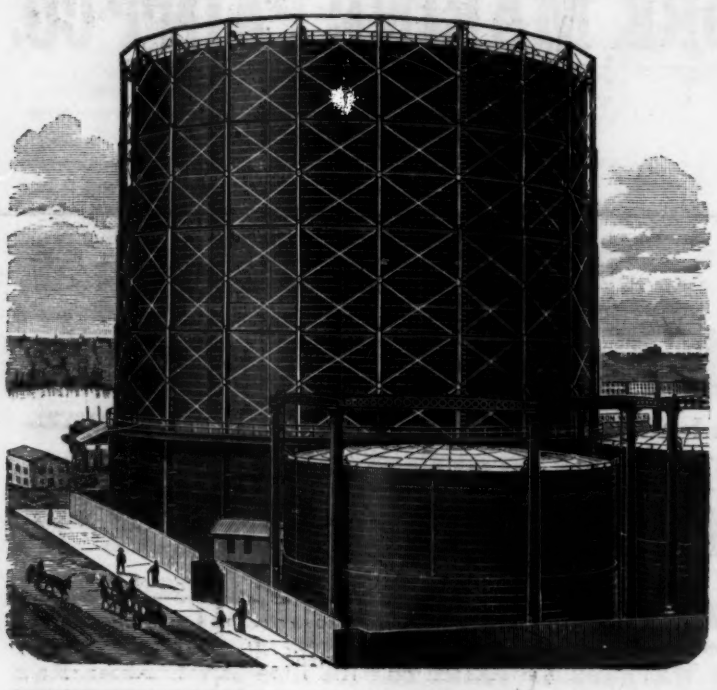

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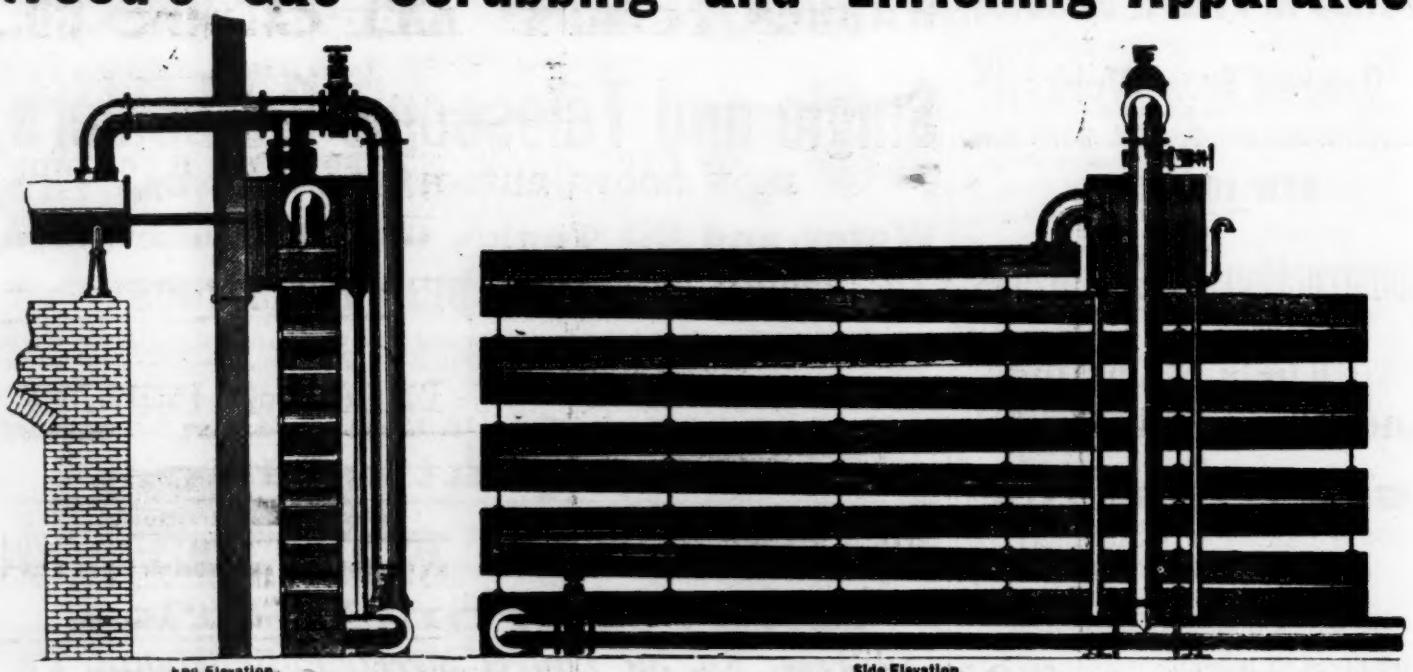

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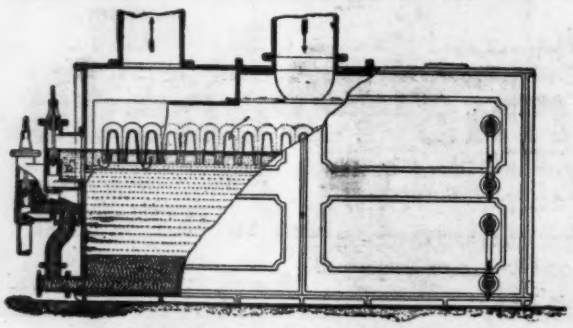

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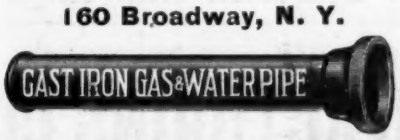

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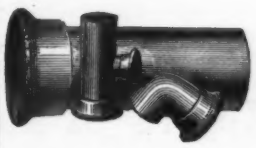

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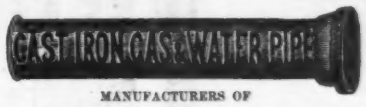

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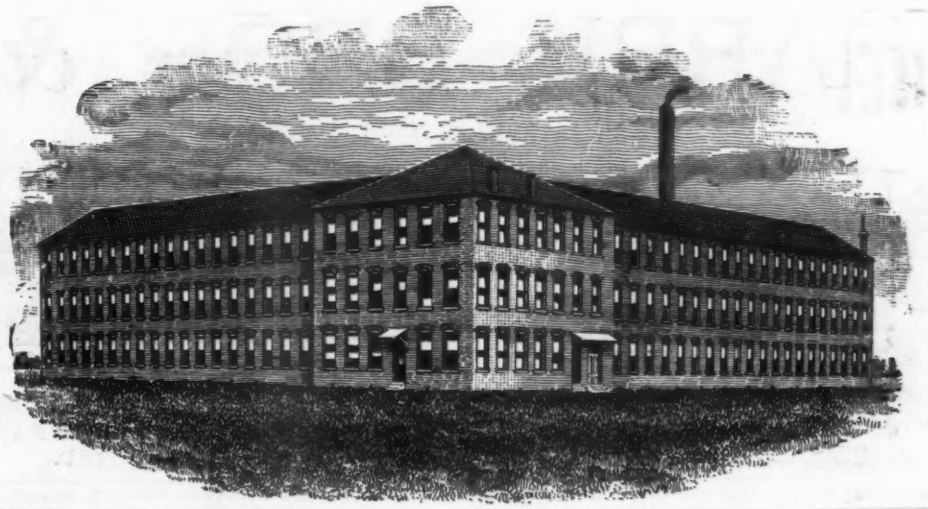

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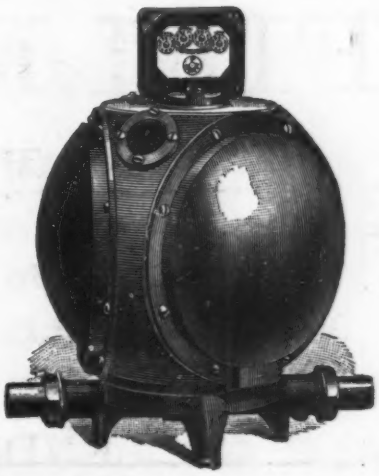

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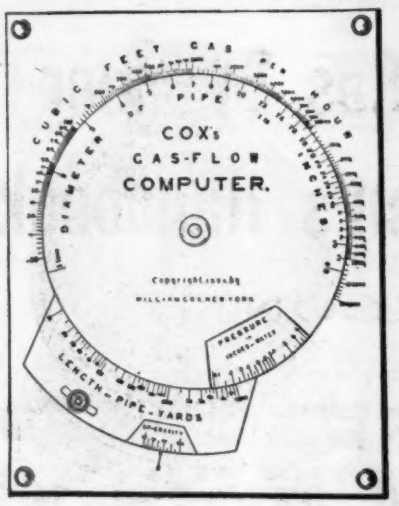

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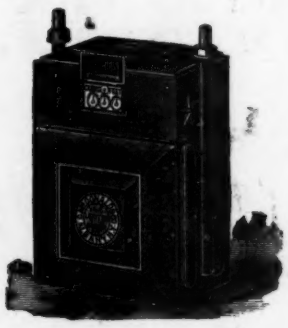

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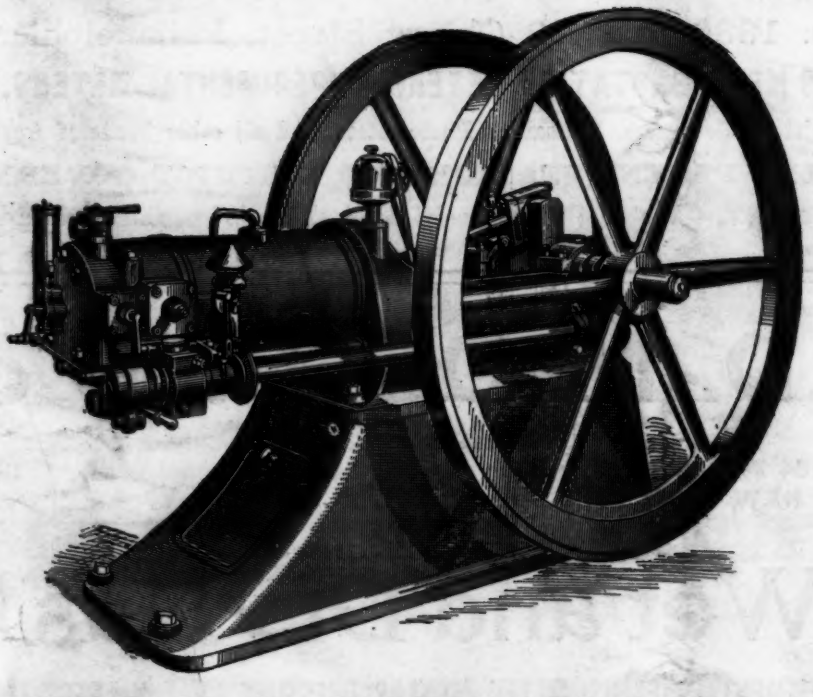

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